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REPORT OF PROCEEDINGS
Thirteenth Annual Meeting

# American Wood-Preservers' Association

AT NEW YORK, N. Y.
Nineteen Hundred and Seventeen

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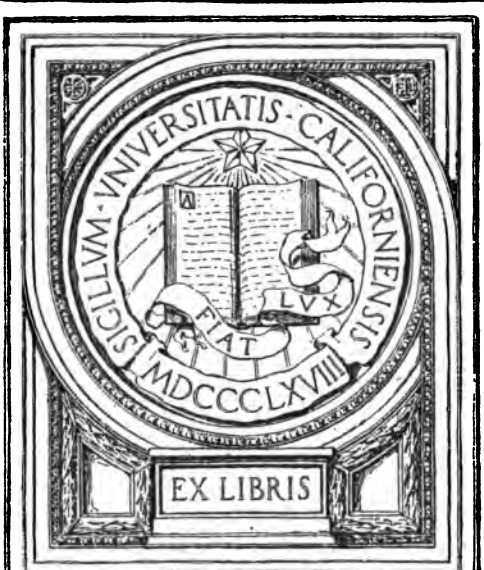


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# PROCEEDINGS

OF THE

## Thirteenth Annual Meeting

OF THE

# American Wood-Preservers' Association

OF
CALIFORNIA

HELD AT

**HOTEL ASTOR, NEW YORK**

**JANUARY 23, 24, 25, 1917**

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**JOHN FOLEY**
**President, 1917**

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# AMERICAN WOOD-PRESERVERS' ASSOCIATION

## Constitution

(Amended 1912, 1915, 1916)

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### ARTICLE I.

*Name and Objects.*

SECTION 1. The name of this Association shall be the AMERICAN WOOD-PRESERVERS' ASSOCIATION.

SECTION 2. The objects of the Association shall be the promotion of knowledge of the materials, methods, and principles involved in the economic design, location, construction, maintenance, and operation of wood-preserving works; the standardization of specifications for wood preservatives and for their introduction into the material to be preserved; and the maintenance of high standards of business ethics in the wood-preserving industry.

SECTION 3. The means to be used for these purposes shall be meetings for the presentation and discussion of reports of the experiences and investigations of its members and others, for the interchange of ideas, and for social intercourse; the publication of desirable information; and co-operation with organizations or individuals in work affecting wood-preserving.

### ARTICLE II.

*Membership.*

SECTION 1. The Association shall consist of Corporate, Associate, Probate, and Honorary members.

SECTION 2. A Corporate Member shall be an executive, an administrator, or an operative in a wood-preserving organization; an officer of a public-utility corporation using treated wood whose duties cover the purchasing, inspecting, treating, or distribution of such material; a chemist or an engineer in the employ of a city, county, state, nation, or public-utility corporation; a consulting chemical, civil, electrical, forest, or mechanical engineer; or a professor or an instructor in an institution of learning.

SECTION 3. An Associate Member shall be any person or association of persons interested in wood preservation or in the sale of material or equipment used in the wood-preserving industry.

SECTION 4. A Probate Member shall be an employe of a wood-preserving or inspecting organization who is not eligible for Corporate Membership.

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SECTION 5. An Honorary Member shall be a person of acknowledged eminence in the wood-preserving industry or the sciences relating thereto. The number of Honorary Members shall not exceed five.

SECTION 6. Corporate Members shall have all the rights and privileges of the Association.

SECTION 7. Associate Members shall have all the rights of Corporate Members, except those of voting or holding office.

SECTION 8. Probate Members shall have all the rights of Corporate Members, except those of voting or holding office, for five years from the date of their admission, when their status shall be determined by the Executive Committee.

SECTION 9. Honorary Members shall have all the rights of Corporate Members, except that of holding office, and shall be exempt from the payment of dues.

## ARTICLE III.

### *Admissions and Expulsions.*

SECTION 1. Applications for membership and resignations from membership shall be transmitted to the Secretary-Treasurer, the former on a form prescribed by the Executive Committee and endorsed by a Corporate or an Honorary Member. The Secretary-Treasurer shall forward a copy of each application for membership to each member of the Executive Committee, the affirmative votes of a majority of whom shall admit the candidate.

SECTION 2. Proposals for Honorary Membership shall be made by at least ten members, none of whom shall be a member of the Executive Committee. The nominee shall be declared an Honorary Member if he receives the unanimous vote of the Executive Committee or the votes of two-thirds of the Corporate and Honorary members.

SECTION 3. Any member of the Association who resigns while in good standing may be reinstated without paying a second admission fee, provided his application is approved by two-thirds of the Executive Committee.

SECTION 4. For unbecoming conduct a member may be expelled by the votes of two-thirds of the members at an Annual Meeting, after the member has been served with written particulars as to his offense by the Executive Committee, and had an opportunity to be heard by it or by the members at an Annual Meeting.

SECTION 5. The Executive Committee shall accept the resignation, tendered in writing, of any member whose dues are paid.

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## ARTICLE IV.

*Dues.*

SECTION 1. On admission to the Association, members shall pay fees as follows: Corporate Members, $10.00; Associate Members, $15.00; Probate Members, $5.00, which shall include their first dues.

SECTION 2. The annual dues, payable during the first two months of the calendar year, shall be as follows: Corporate Members, $10.00; Associate Members, $10.00; Probate Members, $5.00.

SECTION 3. Members admitted after March 31 shall be exempt from the payment of dues until the following January 1, unless they desire to vote or to receive the current publications of the Association, in which case they shall pay one-half of the annual dues.

SECTION 4. Any member whose dues are unpaid on April 1 shall not receive the publications of the Association, and if his dues are not paid by December 31, his membership shall be canceled, except as provided for in Section 5 of this Article.

SECTION 5. The Executive Committee may extend the time for paying or remit the dues of any Corporate or Probate members who are unable to pay them.

## ARTICLE V.

*Officers.*

SECTION 1. The officers of the Association shall be Corporate Members and shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary-Treasurer, and six Members of Executive Committee, who, together with the last Past-President who is a Corporate Member, shall constitute the Executive Committee in which responsibility for the government of the Association shall be vested. The President shall be chosen from the nine eligible members of the Executive Committee.

SECTION 2. No two or more officers in any year shall be members of the same business organization.

SECTION 3. The President, the First Vice-President, the Second Vice-President, the Secretary-Treasurer, and two Members of Executive Committee shall be elected at each Annual Meeting.

SECTION 4. The terms of the President, Vice-Presidents, and Secretary-Treasurer shall begin at the close of the Annual Meeting at which they are elected and continue until their successors are elected and have qualified. The six Members of Executive Committee shall serve three years, two being elected each year.

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SECTION 5. A vacancy in the office of President shall be filled by the Vice-Presidents in order.

SECTION 6. A vacancy in any office other than that of President shall be filled by an appointee of the Executive Committee.

SECTION 7. The President shall not be eligible for re-election to that office until three others have filled it. A Vice-President shall not be eligible for re-election to the same office until one other has filled it.

## ARTICLE VI.

*Nomination and Election of Officers.*

SECTION 1. At each Annual Meeting six Corporate Members who are not officers shall be elected, together with the three last Past-Presidents who are Corporate Members, to serve one year as a Nominating Committee, of which the senior Past-President shall be chairman.

SECTION 2. The Nominating Committee shall nominate one eligible member for each office and for each membership in the Nominating Committee and shall send its list of nominees to the Secretary-Treasurer before October 15. Any vacancies that may occur in the list of nominees before it is sent to the members shall be filled by the Executive Committee.

SECTION 3. The voting shall not be restricted to the names presented by the Nominating Committee. Any member may file with the Secretary-Treasurer before November 1 the name of a candidate for any office.

SECTION 4. The ballot, with envelopes for secret voting, shall be sent to each member before December 1. It must contain the names of all nominees for each office, arranged alphabetically where there is more than one name for any office, with the nominees of the Nominating Committee plainly indicated.

SECTION 5. Members may scratch or substitute the name of any nominee for any office.

SECTION 6. Ballots shall be sealed and sent or delivered to the Secretary-Treasurer before the polls close, prior to which time a voter may withdraw or replace his ballot.

SECTION 7. The polls shall be closed at noon on the first day of the Annual Meeting, and the ballots shall be counted by one Corporate and four Associate or Probate Members, appointed tellers by the presiding officer at the Annual Meeting.

SECTION 8. The persons who receive the highest number of votes for the offices for which they are candidates shall be declared elected. In case of a tie between candidates for the same office, the members pres-

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ent at the Annual Meeting shall elect the officer from the candidates so tied. The presiding officer shall announce to the meeting the names of the officers elected.

## ARTICLE VII.

### *Management.*

SECTION 1. The President shall have general supervision of the affairs of the Association, shall preside at its meetings and those of the Executive Committee, and shall be a member *ex-officio* of every committee except the Nominating Committee.

SECTION 2. The Vice-Presidents, in order of seniority, shall preside at meetings in the absence of the President, and discharge his duties in case of a vacancy in the office.

SECTION 3. The Secretary-Treasurer, under the direction of the President and the Executive Committee, shall be the executive officer of the Association. He shall conduct the correspondence of the Association; record the proceedings of all meetings; collect and deposit all moneys due the Association; verify all bills and pay them when approved by the President or Executive Committee; make at each Annual Meeting a report of the accounts and membership of the Association; and perform such other duties as may be assigned to him by the Executive Committee.

SECTION 4. The Executive Committee shall manage the affairs of the Association, and shall have full power to control and regulate all matters not provided for in the Constitution. It shall act on applications for membership; make appropriations for specific purposes; direct the care of the surplus funds of the Association; and audit the accounts of the Secretary-Treasurer.

SECTION 5. The Executive Committee shall publish the activities of the Association in a book to be known as the Annual Proceedings; but, subject to the action of the Association, it may withhold, in whole or in part, discussions, papers, or reports, the propriety or soundness of which it considers questionable.

SECTION 6. The Executive Committee shall have printed a Manual of Recommended Practice, in which shall be published the specifications and standards approved by the Association in accordance with Article X.

SECTION 7. The Executive Committee shall meet at such times and places as the President may direct, or five members may request in writing. Six members shall constitute a quorum.

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## ARTICLE VIII.

### *Meetings.*

SECTION 1. An Annual Meeting, at which the officers shall be elected and all annual reports read, shall be held on the fourth Tuesday in January of each year, at ten o'clock A. M., at such place as the Association at the previous meeting may designate.

SECTION 2. Whenever the President may deem it necessary, or upon the written application of fifteen Corporate Members, he shall direct the Secretary-Treasurer to call a special meeting. The call for such a meeting shall state the time, place, and purpose of the meeting, and shall be mailed not less than thirty days prior to the date of the proposed meeting.

SECTION 3. Twenty Corporate Members shall constitute a quorum at any meeting of the Association.

SECTION 4. The order of business at the meetings of the Association shall be arranged by the Executive Committee, subject to addition or change by the votes of the majority of the members present.

## ARTICLE IX.

### *Amendments.*

SECTION 1. Proposed amendments to this Constitution must be offered in writing, signed by at least five Corporate Members, and forwarded to the Secretary-Treasurer not less than thirty days prior to the Annual Meeting. They shall be published with the notices for the meeting.

SECTION 2. Proposed amendments shall be in order for discussion at the Annual Meeting, and may be amended and adopted if two-thirds of the votes of the Corporate and Honorary members present and voting are affirmative.

## ARTICLE X.

### *Adoption of Standards.*

SECTION 1. Any proposals for the approval or recommendation by the Association, of definitions, methods, nomenclature, specifications, standard construction, or standard practice, or aimed at defining formally the position of the Association on any matter of importance, shall be presented in writing, with drawings if necessary, at an Annual Meeting. At this meeting amendments may be made by a majority of the Corporate and Honorary members present and voting. Proposed standards shall be referred to letter ballot of the Association if two-thirds of the Corporate and Honorary members at an Annual Meeting vote affirmatively. The affirmative votes of two-thirds of all the Corporate and Honorary members shall be required for the adoption of any standard.

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**Past and Present Officers of the American Wood-Preservers' Association.**

| Number | Year Elected. | President. | First Vice-President | Second Vice-President | Third Vice-President | Secretary-Treasurer |
|---|---|---|---|---|---|---|
| 1st..... | 1905 | J. S. Baker | C. B. Lowry† | H. J. Whitmore† | F. A. Kummer* | C. W. Berry |
| 2nd..... | 1906 | C. B. Lowry† | E. O. Faulkner | Edmund Christian | David Allerton | C. W. Berry |
| 3rd..... | 1907 | C. B. Lowry† | David Allerton | Walter Buehler | H. S. Valentine | C. W. Berry |
| 4th..... | 1908 | Walter Buehler | C. B. Lowry† | David Allerton | H. S. Valentine | C. W. Berry |
| 5th..... | 1909 | Walter Buehler | David Allerton | H. S. Valentine | H. M. Rollins | C. W. Berry |
| 6th..... | 1910 | Walter Buehler | C. W. Berry | David Allerton | C. D. Chanute† | F. J. Angier |
| 7th..... | 1911 | John T. Logan | Andrew Gibson | R. J. Calder | D. Burkhalter | F. J. Angier |
| 8th..... | 1912 | E. A Sterling | A. M. Smith | H. M. Rollins | G. B. Shipley | F. J. Angier |
| 9th..... | 1913 | A. E. Larkin | J. H .Waterman | E. B. Fulks | Geo. E. Rex | F. J. Angier |
| 10th..... | 1914 | Geo. E. Rex | Carl G. Crawford | R. S. Manley | F. B. Ridgway* | F. J. Angier |
| 11th..... | 1915 | J. H. Waterman | H. S. Loud | Lowry Smith | F. D. Beal | F. J. Angier |
| 12th..... | 1916 | Carl G. Crawford | John Foley | M. K. Trumbull | ..... | F. J. Angier |
| 13th..... | 1917 | John Foley | M. K. Trumbull | J. B. Card | ..... | F. J. Angier |

†Deceased. *Resigned.

In 1915 the Executive Committee was increased to 11 members, the 6 additional members to serve from 1 to 3 years. In 1916 the office of Third Vice-President was abolished.

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**Meetings.**

| Year. | City. | Hotel. | Members Present. | Visitors Present. | Number of Pages in Proceedings. | Number of Papers and Reports Presented. |
|---|---|---|---|---|---|---|
| 1905..... | New Orleans | St. Charles | 15 | No record | 37 | 7 |
| 1906..... | Chicago | Palmer House | 16 | No record | 56 | 9 |
| 1907..... | Memphis | Baltimore | 16 | No record | 64 | 10 |
| 1908..... | Kansas City | Gayoso | No record | No record | Not issued | .. |
| 1909..... | Chicago | Auditorium | .. | 100 | 141 | 12 |
| 1910..... | Chicago | Auditorium | 24 | 74 | 190 | 14 |
| 1911..... | Chicago | Auditorium | 50 | 70 | 302 | 20 |
| 1912..... | Chicago | Sherman | 67 | .. | 348 | 17 |
| 1913..... | Chicago | Sherman | 83 | 36 | 525 | 22 |
| 1914..... | New Orleans | St. Charles | 65 | 43 | 544 | 25 |
| 1915..... | Chicago | Congress | 122 | 105 | 527 | 23 |
| 1916..... | Chicago | Sherman | 115 | 89 | 432 | 31 |
| 1917..... | New York | Astor | 100 | 133 | 538 | 26 |

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## OFFICERS.

John Foley.....President
M. K. Trumbull.....First Vice-President
J. B. Card.....Second Vice-President
F. J. Angier.....Secretary-Treasurer

## EXECUTIVE COMMITTEE.

John Foley, *Chairman*

F. J. Angier
Carl G. Crawford
Geo. M. Davidson
A. R. Joyce
C. M. Taylor
J. B. Card
V. K. Hendricks
F. S. Pooler
Geo. E. Rex
M. K. Trumbull

### Committee No. 1—Meeting.

M. K. Trumbull, *Chairman*

**Program.**
M. K. Trumbull, *Chairman*
J. B. Card
V. K. Hendricks
F. S. Pooler
Geo. E. Rex

**Entertainment.**
A. L. Kuehn, *Chairman*
F. S. Pooler
E. J. Roth
E. J. Stocking

### Committee No. 2—Publications.

John Foley, *Chairman*

E. W. Bright
E. G. Draper
Wm. A. Fisher
C. E. Gosline
Frank Schilling
L. B. Shipley

### Committee No. 3—Promotion and Education

E. A. Sterling, *Chairman*

John S. Bates
Nelson C. Brown
F. V. Dunham
E. T. Howson
S. J. Record
P. S. Ridsdale
Chas. C. Schnatterbeck
O. T. Swan

### Committee No. 4—Service Tests.

P. R. Hicks, *Chairman*

**Ties and Timber.**
E. H. Bowser, *Chairman*
C. F. Ford
W. H. Fulweiler
F. D. Mattos
H. M. Rollins
H. von Schrenk

**Flooring and Paving.**
A. W. Dow, *Chairman*
F. D. Beal
E. R. Dutton
L. T. Ericson
R. S. Manley
J. C. Williams

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### Committee No. 5—Plant Operation.

C. W. Lane, *Chairman*

G. S. Harden
Geo. M. Hunt
A. M. Lockett
H. S. Loud
August Meyer
E. E. Pershall
R. H. Rawson
J. M. Weber

### Committee No. 6—Preservatives.

E. B. Fulks, *Chairman*

S. F. Acree
S. R. Church
C. N. Forrest
A. L. Kammerer
O. C. Steinmayer
C. M. Taylor

### Committee No. 7—Purchase and Preservation of Treatable Timber.

A. R. Joyce, *Chairman*

J. B. Card
O. P. M. Goss
F. R. Martin
Geo. E. Rex
H. S. Sackett
M. T. Shanesey
Lowry Smith
T. G. Townsend
H. S. Valentine
C. P. Winslow

### Committee No. 8—Wood-Block Flooring and Paving.

Clyde H. Teesdale, *Chairman*

Walter Buehler
Frank W. Cherrington
A. L. Kuehn
H. M. Newton
A. H. Noyes
Albert Stamford

### Committee No. 9—Terminology.

J. B. Card, *Chairman*

F. J. Angier
W. H. Grady
J. H. Grow
Grant B. Shipley

### Committee No. 10—Non-Pressure Treatments.

R. A. Griffin, *Chairman*

W. M. Carpenter
E. T. Chapin
L. L. Hill
Roger F. Hosford

### Committee No. 11—Conference.

Carl G. Crawford, *Chairman*

E. T. Howson
J. H. Waterman

### Committee No. 12—Nominating.

Geo. E. Rex, *Chairman*

J. H. Waterman
Carl G. Crawford
Wm. A. Fisher
E. T. Howson
Richard V. Look
F. D. Mattos
August Meyer
A. H. Noyes

NOTICE—The Association is not responsible as a body for the opinions expressed by individuals.

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## MEMBERS.

c-Corporate. a-Associate. p-Probate. h-Honorary.
Figures indicate serial number of Membership Certificates.

324 c ACREE, S. F.....In charge Section of Derived Products, Forest Products Laboratory, Madison, Wis.
354 c ADAMSON, G. J.....Division Engineer, Union Pacific System, Cheyenne, Wyo.
183 c ALEXANDER, E. E.....General Foreman, Timber Preserving Plant, Baltimore and Ohio R. R. Co., Green Spring, W. Va.
29 c ALLARDYCE, R. L.....Supt., International Creosoting & Construction Co., Texarkana, Tex.
360 a ALLEN, E. J..... Ties and Lumber, 32 Broadway, New York.
21 c ALLERTON, DAVID.....Carlotta, Cal.
1 c ANGIER, F. J.....Supt. of Timber Preservation, Baltimore and Ohio R. R. Co., Baltimore, Md.
274 c APPEL, HARRIS A.....Engineer, S. P. F. Wood-Preserving Co., 90 Wall Street, New York.
2 c ARMSTRONG, R. L.....636 Burdette St., New Orleans, La.
105 c BACON, W. L.....Supt., Tie Treating Plant, C. & N. W. Ry., Escanaba, Mich.
3 h BAKER, J. S.....Box 22, Paducah, Ky.
167 c BATEMAN, ERNEST.....Chemist, Forest Products Laboratory, Madison, Wis.
246 c BATES, JOHN S.....Supt., Forest Products Laboratories, McGill University, Montreal, Canada.
88 c BATSON, C. D.....Mgr., Republic Creosoting Co., Mobile, Ala.
361 c BATTENHOUSE, WM.... Supervisor Maintenance of Way and Equipment Lumber, Baltimore and Ohio R. R., Baltimore, Md.
4 c BEAL, F. D.....Engineer, 414 Insurance Exchange, San Francisco, Cal.
255 c BEATY, R. ERNEST.....Expert Inspector, Borough of Manhattan, Room 3002, 165 Broadway, New York.
198 c BECKER, A. C.....Terminal House, St. Louis, Mo.
145 c BELCHER, R. S.....Supt., Treating Plant, Santa Fe Tie & Lumber Preserving Co., Somerville, Tex.
144 c BERK, P. F.....Chemical Manufacturer, F. W. Berk & Co., Ltd., 1 Fenchurch Ave., London, England.
5 h BERRY, C. W.....Consulting Engineer, care of J. B. Berry, Transportation Bldg., Chicago, Ill.
300 c BLACK, JAMES M.....Paving Block Expert, 203 Pasadena Apartments, Jefferson & Du Bois Sts., Detroit, Mich.
22 c BOEHNE, E. E.....Mgr., Sales Department, International Creosoting & Construction Co., Galveston, Tex.
258 c BOOK, J. E.....Treating Engineer, Pacific Creosoting Co., Creosote, Wash.
244 c BOWSER, E. H.....Supt. of Timber Department, I. C. R. R., Memphis, Tenn.
267 a BOYD, J. L.....Chief Engineer, Creosoted Block Paving Co., Royal Bank Bldg., Toronto, Canada.
280 p BRENNAN, T. S.....Lumber Inspector, A., T. & S. F. Ry., Box 303, Ballard Station, Seattle, Wash.
368 a BREYER, FRANK G.....Chief of Research Dept., New Jersey Zinc Co., Palmerton, Pa.
301 c BRIGHT, EDGAR W.....Tie & Timber Agent, Boston Elevated Rwy. Co., 101 Milk St., Boston, Mass.
340 c BROWN, FRANK I.....Lumber Agent, Penna. Lines West of Pittsburgh, Fort Wayne, Ind.
230 c BROWN, NELSON C.....Professor of Forest Utilization, New York State College of Forestry, Syracuse, N. Y.
122 c BRUNING, HEINRICH...(Robert A. Munro & Co., 31 Liberty St., New York) Hubertusmuhle, Schopfurth, Mark, Germany.
23 c BUEHLER, WALTER.....Consulting Engineer in Wood Preservation, The Barrett Co., 10 So. La Salle St., Chicago, Ill.
24 c BURKHALTER, D.....American Creosoting Co., Box 77, Russell, Ky.
338 c BURY, RICHARD A.....Asst. Gen. Tie Agent, N. Y. C. Lines, 76 Seward Ave., Detroit, Mich.

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83 a CABOT, SAMUEL.....Manufacturing Chemist, 141 Milk St., Boston, Mass.
30 c CALDER, R. J.....Secy.-Treas., International Creosoting & Construction Co., Galveston, Tex.
190 c CAMPBELL, J. H.....Chemical Engineer, R. W. Hunt & Co., 2200 Insurance Exchange, Chicago, Ill.
43 c CARD, J. B.....Prest., Central Creosoting Co., 111 W. Washington St., Chicago, Ill.
352 c CARPENTER, W. M.....Vice-Prest., American Cross Arm Co., McCormick Bldg., Chicago, Ill.
276 c CECIL, WM. A.....Wood-Preserving Engineer, Indiana Tie Co., Citizens National Bank Building, Evansville, Ind.
257 c CHADBOURNE, B.....Asst. Supt., Pacific Creosoting Co., Northern Life Bldg., Seattle, Wash.
302 c CHAPIN, E. T.....Prest., The E. T. Chapin Co., Columbia Bldg., Spokane, Wash.
69 c CHERRINGTON, F. W....Chief Engr., Jennison-Wright Co., 313 Huron St., Toledo. O.
19 c CHRISTIAN, EDMUND...Gen. Mgr., Norfolk Creosoting Co., Norfolk, Va.
57 a CHURCH, SUMNER R....Manager, Research Dept., The Barrett Co., 17 Battery Place, New York.
165 c CLARKE, G. S.....Vice-Prest. & Gen. Mgr., The Reeves Co., 809 Whitney-Central Bldg., New Orleans, La.
184 c CLARK, W. DENNISON..Vice-Prest. & Gen. Mgr., Columbia Creosoting Co., 810 Lewis Bldg., Portland, Ore.
318 c CLEMENTS, A. B.....Vice-Prest., United States Wood Preserving Co., 165 Broadway, New York.
319 p CLEMENTS, CYRIL M...Salesman, The Barrett Co., Philadelphia, Pa.
174 c CLIFTON, W. H.....Lumber Agent, Baltimore & Ohio R. R. Co., Baltimore, Md.
249 c COBEAN, CHAS. E.....Supt., Pacific Creosoting Co., Creosote, Wash.
188 a COCKE, W. H.....Prest., Commercial Acid Co., 3943 Duncan Ave., St. Louis, Mo.
157 c COLLIER, H. L.....Chief of Construction City of Atlanta, Atlanta, Ga.
365 c COLLINS, E. S.....Prest., Sheffield & Tionesta Rwy. Co., Kellettville, Pa.
218 c COLLIVER, S. R.....Treatment Inspector, A., T. & S. F. Ry., Topeka, Kan.
67 c COLMAN, GEO. A.....The J. M. Colman Co., Colman Bldg., Seattle, Wash.
366 c CONWAY, JOHN L.....Supt., Pittsburgh Wood Preserving Co., Connellsville, Pa.
221 c COOPER, S. D.....Chief Inspector, A., T. & S. F. Ry., Topeka, Kan.
31 c CRAWFORD, CARL G....Gen. Mgr., American Creosoting Co., 808 Columbia Bldg., Louisville, Ky.
80 c CURTIS, W. W.....Prest. & Treas., The Rapson Coal Mining Co., Box 485, Colorado Springs, Colo.
25 c DAVIDSON, G. M.....Chemist and Engineer of Tests, C. & N. W. Ry. Co., Chicago, Ill.
143 c DAVIES, E. T.....Inspector, City Engineer's Office, Minneapolis, Minn.
84 c DE CEW, J. A.....Chemical Engineer, McGill Bldg., Montreal, Canada.
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### Railroads.

ATCHISON, TOPEKA & SANTA FE:
Belcher, R. S.
Brennan, T. S.
Colliver, S. R.
Cooper, S. D.
Faulkner, E. O.
Jackson, W. E.
Keig, J. R.
Kroemer, F. W.
Murray, D. L.
Perry, A. W.
Rex, Geo. E.
Waddell, K. M.

ATLANTIC COAST LINE:
Pollock, S. T.

BALTIMORE & OHIO:
Alexander, E. E.
Angier, F. J.
Battenhouse, Wm.
Clifton, W. H.
Irving, A. E.
Lane, C. W.
Myerly, J. R.
Rowland, J. W.
Schnatterbeck, C. C.
Stimson, Earl
von Leer, H. J.

BOSTON ELEVATED:
Bright, E. W.

BUFFALO, ROCHESTER & PITTSBURGH:
Harden, G. S.
Hoyt, H. B.
Woodward, G. W.

CANADIAN PACIFIC:
Dixon, J. H.

CENTRAL OF GEORGIA:
Stewart, F. H.

CHICAGO, BURLINGTON & QUINCY:
Haggander, G. A.
Meyer, A.
Waterman, J. H.
Williamson, H. E.

CHICAGO & EASTERN ILLINOIS:
Martin, F. R.

CHICAGO GREAT WESTERN:
Graham, Floyd N.

CHICAGO, INDIANAPOLIS & LOUISVILLE:
Kent, A. S.
Roth, E. J.
Stull, T. G.

CHICAGO, MILWAUKEE & ST. PAUL:
Pinson, J. F.
Pooler, F. S.

CHICAGO & NORTHWESTERN:
Bacon, W. L.
Davidson, Geo. M.

CHICAGO, ROCK ISLAND & PACIFIC:
Ford, C. F.
Paul, H. A.

DALLAS, CORSICANA & PALESTINE:
Mitchell, L. E.

DELAWARE, LACKAWANNA & WESTERN:
Gosline, C. E.

EL PASO & SOUTHWESTERN:
Ross, P. A.

ERIE:
Drinker, W. W.
Underwood, F. D.

FRISCO LINES:
Hendricks, V. K.
Steinmayer, O. C.

ILLINOIS CENTRAL:
Bowser, E. H.

LOUISVILLE & NASHVILLE:
Lindsey, John B., Jr.

MILWAUKEE ELECTRIC RWY. & LIGHT:
Stearns, R. B.

MISSOURI, KANSAS & TEXAS:
Noyes, Geo. W.

MISSOURI PACIFIC:
Hammack, M. D.

NEW YORK CENTRAL:
Bury, R. A.
Dixon, G. C.
Shanesey, M. T.

NORTHERN PACIFIC:
Gibson, Andrew
Smith, Lowry

OREGON-WASHINGTON R. R. & NAVIGATION:
Pestel, A. C.

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PENNSYLVANIA:
Brown, F. I.
Foley, John
Hopkins, H. W.

PHILADELPHIA & READING:
Taylor, C. M.

PITTSBURGH & LAKE ERIE:
Smith, W. J.

QUEEN & CRESCENT:
Dougherty, Curtis

SAN PEDRO, LOS ANGELES & SALT LAKE:
Schulz, Harry

SHEFFIELD & TIONESTA:
Collins, E. S.

SOUTHERN:
Finke, W. F. H.
Tilley, C. M.
Townsend, T. G.

SOUTHERN PACIFIC:
Isaacs, John D.
Mattos, F. D.
Mims, L.

TEXAS & NEW ORLEANS:
Lawson, W. W.

UNION PACIFIC:
Adamson, G. J.
Johnson, J. A.

WISCONSIN & NORTHERN:
Hartley, C. H.

## Navigation Companies.

NEW ORLEANS-CUBA STEAMSHIP CO.:
Powell, Ed. L.

## Commercial Treating Plants.

AMERICAN CREOSOTING CO. (Louisville, Ky.):
Burkhalter, D.
Crawford, C. G.
Durham, J. H.
Grady, W. H.
Hert,, A. T.
Moore, R. H.
Taylor, Thos. B.

AMERICAN CREOSOTING CO., N. J.
Draper, Ernest
Manion, Keron
Zeller, W. C.

AMERICAN CREOSOTING WORKS:
Labrot, S. W.
White, Thos.

ATLANTIC CREOSOTING & WOOD PRESERVING WORKS:
Parrott, R. D.

AYER & LORD TIE CO.:
Lord, Russell
Noyes, A. H.
Smith, A. M.

BARBER ASPHALT PAVING CO.:
Forrest, Chas. N.
Williams, J. C.

BURT, BOULTON & HAYWOOD, LTD.:
Fergusson, Hubert

CANADA CREOSOTING CO.:
Look, Richard V.
McCandless, S. F.
Wallace, H.

CARBOLINEUM WOOD PRESERVING CO.:
Hartman, E. F.
Paddock, Edw. F.

CENTRAL CREOSOTING CO.:
Card, J. B.
Stocking, E. J.

COLMAN, THE J. M. CO.:
Colman, Geo. A.

COLUMBIA CREOSOTING CO.:
Clark, W. Dennison
Green, D. W.

COMPRESSED WOOD PRESERVING CO.:
Frey, Geo. W.

CONTINENTAL TIE & LUMBER CO.:
Schomburg, T. A.

DOMINION TAR & CHEMICAL CO.:
Smith, E. Bernard

EPPINGER & RUSSELL CO.:
Eppinger, Jesse I.
Schilling, Frank
Valentine, H. S.

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GUIDO RUTGERS KAMMANDIT CO.:
Schmook, Karl

GULFPORT CREOSOTING CO.:
Fant, A. E.
Rollins, H. M.

HUELSBERG & CO.:
Kuckuck, Berthold
Rueping, Max
Sternberg, Leo

INDIANA TIE CO.:
Cecil, Wm. A.
Williams, R. R.

INDIANA ZINC CREOSOTING CO.:
McArdle, Frank

INTERNATIONAL CREOSOTING & CONSTRUCTION CO.:
Allardyce, R. L.
Boehme, E. E.
Calder, R. J.

JENNISON-WRIGHT CO.:
Cherrington, F. W.
Drinker, L. P.
Ericson, L. T.
Jennison, H. G.

JOYCE-WATKINS CO.:
Joyce, A. R.
Van Metre, R.
Watkins, W. T.

KETTLE RIVER CO.:
Moses, L. B.
Pershall, E. E.

LOUISIANA CREOSOTING CO.:
La Grone, J. M.

MIDLAND CREOSOTING CO.:
Newton, H. M.

MOSS, T. J. TIE CO.:
Fristoe, J. W.

MUNRO, R. A. & CO.:
Bruning, Heinrich

NAUGLE POLE & TIE CO.:
Morier, L. E.

NATIONAL LUMBER & CREOSOTING CO.:
Grimes, I. B.
Harris, Page
Logan, John T.
Ryan, W. J.
Trumbull, M. K.

NORFOLK CREOSOTING CO.:
Christian, Edmund
Smith, P. A.

OHIO WOOD PRESERVING CO.:
Conway, John L.
Park, E. S.
Rambo, E. B.
Weber, J. M.

PACIFIC CREOSOTING CO.:
Book, J. E.
Chadbourne, B.
Cobean, Chas. E.
Delius, E. A.
Horricks, H. E.
Thomas, M. A.

PIONEER LUMBER & CREOSOTING CO.:
Russell, H. C.

PITTSBURGH WOOD PRESERVING CO.:
Shipley, Grant B.

REEVES CO.:
Clarke, G. S.

REPUBLIC CREOSOTING CO.:
Batson, C. D.
Hess, L. E.
Larkin, A. E.
Rufli, H. M.
Shuford, C. S.
Welsh, C. T.

RUTGER WORKS:
Segall, S.
Zwingauer, N.

ST. HELENS CREOSOTING CO.:
Fairley, R. H.
Rawson, R. H.

ST. PAUL & TACOMA LUMBER CO.:
Griggs, E. G.
Lane, C. E.
Wegener, Ralph H.

SOUTHERN CREOSOTING CO.:
Dunstan, J. H.

SOUTHERN WOOD PRESERVING CO.:
Meredith, W. C.

UNITED GAS IMPROVEMENT CO.:
Fulweiler, W. H.

UNITED STATES WOOD PRESERVING CO.:
Clements, A. B.
Stamford, A.

VANCOUVER CREOSOTING CO.:
Hermann, Geo. E.
Redman, Kenneth

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WASHINGTON CREOSOTING CO.:
Winslow, Geoffrey

WATKINS CREOSOTING CO.:
Helson, J. R.

WESTERN WOOD PRESERVING CO.:
Lindley, S. B.

## Tie and Timber Companies.

ACME TIE CO.:
Tiffany, C. W.

ALLEN, E. J.

AMERICAN CROSS ARM CO.:
Carpenter, W. M.

CHAPIN, E. T. CO.:
Chapin, E. T.

CREOSOTED BLOCK PAVING CO.:
Boyd, J. L.
Lattimore, C. H.

CREOSOTED MATERIALS CO.:
Manley, R. S.

ELLIOTT, J. A. TIE CO.:
Elliott, J. A.

GOLTRA, W. F. TIE CO.:
Goltra, W. F.

JOHNSON, B. & CO.:
Johnson, J. H.

LEE, HOBART, TIE CO.:
Lee, Robert E.

LONG BELL LUMBER CO.:
Fritz, Chas. C.
Parminter, L. I.

MITSUI & CO.:
Teshima, Tomotake

NATIONAL POLE CO.:
Sporley, Chas. M.

NORTHERN TIMBER PRODUCTS CO.:
Lange, L. H.

PAGE & HILL CO.:
Hill, L. L.

RAILWAY TIE TREATING:
Loud, H. S.

RODD CO., THE:
Rodd, Thos., Jr.

SIGNOR TIE CO.:
Signor, Geo. W.

SOUTHERN TIE & LUMBER CO.:
Swink, R. B.

VALENTINE-CLARK CO.:
Furlong, L. A.

WALSH-GRIFFITH TIE & LUMBER CO.:
Walsh, R. P.

WESTERN TIE & LUMBER CO.:
Nixon, E. A.
Nixon, Warren C.

## Chemical and Other Manufacturing Companies.

ALLIS-CHALMERS MFG. CO.:
Gibson, W. C.
Grow, J. H.

AMERICAN TAR PRODUCTS CO.:
Fulks, E. B.
Kuehn, A. L.

BARRETT CO., THE:
Buehler, Walter
Church, S. R.
Clements, Cyril M.
Fowler, J. W.
Shipley, L. B.

BERK, F. W. & CO.:
Berk, P. F.

CABOT, SAMUEL, INC.:
Cabot, Samuel

CHATFIELD MFG. CO.:
Sjodahl, H. A.

CLARK BROS. CO.:
Reid, Jos. S.

COMMERCIAL ACID CO.:
Cocke, W. H.

CRANE CO.:
Fenn, F. D.

GENERAL CHEMICAL CO.:
Hawkes, A. W.
Stahl, K. F.

GRASSELLI CHEMICAL CO.:
Drefahl, L. C.
Mills, W. C.

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GREENLEE BROS. & CO.:
Lounsbury, Jas. A.

LEMBCKE, von BERNUTH CO.:
Fisher, Wm. A.
Lange, Albert
Lembcke, G. A.
von Bernuth, Oscar

LEWIS, F. J. MFG. CO.:
Lewis, F. J.
Lewis, Wm. H.
Murphy, Wm. B.

LOCKETT, A. M. CO.:
Lockett, A. M.

LUND, C. A. & CO.:
Lund, C. A.

NEW JERSEY ZINC CO.:
Breyer, Frank G.

NORTHEASTERN CO., THE
Eastwick, Chas. H.

ROCMAC CO., THE
Townsley, Wm., Jr.

ROESSLER & HASSLACHER CHEMICAL CO.:
Foersterling, Hans

S. P. F. CARBOLINEUM WOOD PRESERVING CO.:
Appel, H. A.

STANDARD OIL CO.:
Smith, R. G.

STANDARD TAR PRODUCTS CO.:
Wegener, Richard

WESTERN SILO CO.:
Martin, James R.

## Chemists, Consulting Engineers, Inspectors, Etc.

Allerton, David
Armstrong, R. L.
Baker, J. S.
Beal, F. D.
Beaty, R. Ernest
Becker, A. C.
Berry, C. W.
Campbell, J. H.
DeCew, J. A.
Demuth, R. E.
Dovey, J. Thomas
Dow, Allan W.
Emerson, Harrington
Goss, O. P. M.
Hamilton, F. P.
Hamnett, W. S.
Higgins, Chas. C.
Judge, F. B.
Kammerer, A. L.
Kendrick, J. W.
Martin, Lyman C.
Moll, Dr. Friedrich
Murchie, W. E.
Powell, A. O. J.
Quincy, R. B.
Roberts, G. G.
Robinson, Donald
Smith, Francis P.
Smith, Phil R.
Smith, V. C.
von Schrenk, Dr. Hermann
Weiss, Howard F.
Wright, W. E.

## Governments.

UNITED STATES:
FOREST SERVICE—
Acree, S. F.
Bateman, Ernest
Hicks, P. R.
Hunt, Geo. M.
Teesdale, Clyde H.
Winslow, Carlile P.

UNITED STATES:
NAVY—
Everhart, L. H.

RUSSIA:
Sapojnikoff, Serge

## Educational Institutions.

FOREST RESEARCH INSTITUTE AND COLLEGE, INDIA:
Pearson, Ralph S.

McGILL UNIVERSITY, CANADA:
Bates, John S.
Kynoch, Wm.

YALE UNIVERSITY:
Record, Samuel J.

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## Associations.

AMERICAN FORESTRY ASSOCIATION:
Ridsdale, P. S.

NATIONAL LUMBER MANUFACTURERS' ASSOCIATION:
Kellogg, R. S.
Sackett, H. S.
Sterling, E. A.

NORTHERN HEMLOCK & HARDWOOD MANUFACTURERS' ASSOCIATION:
Swan, O. T.

SOUTHERN PINE ASSOCIATION:
Dunham, F. V.

## Firms Not Classified.

AMERICAN TELEPHONE AND TELEGRAPH CO.:
Hosford, R. F.

ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES:
Hoxie, F. J.

RAPSON COAL MINING CO.:
Curtis, W. W.

WESTERN ELECTRIC CO.:
Griffin, R. A.
Hosford, R. F.
Sexton, C. H.

## Municipalities.

ATLANTA, GA.:
Collier, H. L.

DETROIT, MICH.:
Black, James M.

MINNEAPOLIS, MINN.:
Davies, E. T.
Dutton, Ellis R.

NEW YORK, N. Y.:
Ray, John R.

PHILADELPHIA, PA.:
Goldstein, H. I.

SEATTLE, WASH.:
Orumm, Edmund O.

TORONTO, CANADA:
Marriott, F. G.

## Periodicals.

"AMERICAN FORESTRY":
Ridsdale P. S.

"RAILWAY MAINTENANCE ENGINEER":
Howson, E. T.

"WOOD-PRESERVING":
Schnatterbeck, Chas. C.

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## ATTENDANCE AT THIRTEENTH ANNUAL MEETING.

### Members.

Acree, S. F.
Alexander, E. E.
Angier, F. J.

Bacon, W. L.
Bowser, E. H.
Bright, E. W.
Brown, Nelson C.
Buehler, Walter
Bury, R. A.

Calder, R. J.
Card, J. B.
Cecil, Wm. A.
Chapin, E. T.
Cherrington, Frank W.
Church, S. R.
Cooper, S. D.
Crawford, Carl G.

Davidson, G. M.
Drefahl, L. C.
Drinker, Lloyd P.
Dunstan, J. H.

Eastwick, Chas. H.
Emerson Harrington
Eppinger, J. I.
Ericson, L. T.
Everhart, Lay H.

Fisher, Wm. A.
Foley, John
Forrest, C. N.
Frey, Geo. W.
Fulks, E. B.
Fulweiler, W. H.

Goldstein, H. I.
Goltra, W. F.
Gosline, C. E.
Grady, W. H.
Griffin, R. A.
Grow, J. H.

Hamilton, F. P.
Harden, G. S.
Hartman, E. F.
Hendricks, V. K.
Hill, L. L.
Hoxie, F. J.
Howson, E. T.
Hoyt, H. B.
Hunt, Geo. M.

Isaacs, John D.

Jennison, H. G.
Johnson, J. A.
Joyce, A. R.
Judge, F. B.

Kammerer, A. L.
Kuehn, A. L.

Larkin, A. E.
Lembcke, G. A.
Lewis, W. H.,
Look, Richard B.
Loud, H. S.

Mattos, F. D.
Meredith, W. C.
Mills, W. C.
Moses, L. B.
Murchie, W. E.

Nixon, W. C.
Noyes, A. H.

Paddock, E. F.
Parminter, L. I.
Parrott, R. D.
Paul, H. A.
Pooler, F. S.

Ray, John R.
Record, S. J.
Rex, Geo. E.
Rollins, H. M.
Rowland, J. W.

Schilling, Frank
Schnatterbeck, Chas. C.
Sexton, C. H.
Shanesey, M. T.
Shipley, Grant B.
Shipley, L. B.
Smith, Lowry
Stahl, K. F.
Stamford, Albert
Steinmayer, O. C.
Sterling, E. A.
Stewart, F. H.
Stimson, Earl
Stull, T. G.

Taylor, C. Marshall
Taylor, Thos. B.
Teesdale, Clyde H.
Tilley, C. M.
Townsend, T. G.
Trumbull, M. K.

von Bernuth, O. M.
von Schrenk, Hermann

Waterman, J. H.
Weber, J. M.
Williams, J. C.

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## Non-Members.

ABBOTT, WM. G.....“Times,” New York.
ADAMS, WINSTON D.....Commercial Agent, Bureau of Foreign and Domestic Commerce, New York.
ANGIER, MRS. F. J.....Baltimore, Md.
ANGIER, ROBERT N.....Baltimore, Md.
ARMSTRONG, F. W.....Chicago Association of Commerce, Chicago, Ill.
BACON, MRS. W. L.....Escanaba, Mich.
BAIRD, MISS C. R. D.....Philadelphia, Pa.
BERDEN, W. H.....Sales Manager, Warren Refining & Chemical Co., Cleveland, O.
BERNHARDT, J. E.....Assistant Engineer, C. & E. I. R. R., Chicago, Ill.
BERNHARDT, MRS. J. E.....Chicago, Ill.
BILYEV, CHAS. S.....Manager, Hildreth & Co., Consulting and Inspecting Engineers, New York.
BLANCHARD, A. H.....Consulting Highway Engineer, New York.
BRADNEY, J. O.....General Manager, Hilke Stacker Co., Middletown, N. Y.
BRIGHT, MRS. E. W.....Brookline, Mass.
BRYAN, J. H.....Business Representative, “Railway Maintenance Engineer,” New York.
BUEHLER, MRS. W.....Chicago, Ill.
CAMP, W. M.....Editor, “Railway Review,” Chicago, Ill.
CAMPBELL, CHAS. L.....“Journal of Commerce,” New York.
CAMPBELL, W. A.....Superintendent, Grenada Plant, Ayer & Lord Tie Co., Tie Plant, Miss.
CAMPBELL, MRS. W. A.....Tie Plant, Miss.
CAMPBELL, R. H.....Director of Forestry, Government of Canada, Ottawa.
CHADWICK, CHAS. S.....Secretary-Treasurer, Eppinger & Russell Co., New York.
CHALLY, E. C.....Superintendent, Federal Creosoting Co., Paterson, N. J.
CHAPIN, MRS. E. T.....Spokane, Wash.
CIMIOTTE, GUSTAV F.....Carbolineum Wood-Preserving Co., New York.
COGHILL, JAMES H.....“Evening Post,” New York.
CONWAY, S. C.....Sales Engineer, Ayer & Lord Tie Co., Philadelphia, Pa.
CRANDALL, JOHN S.....Consulting Engineer, The Barrett Co., New York.
DRESSER, GEO. L.....Sales Engineer, Jennison-Wright Co., Albany, N. Y.
DRINKER, MRS. LLOYD P.....Philadelphia, Pa.
DUBERSTEN, J.....Auditor, Carbolineum Wood-Preserving Co., New York.
DUBIN, MRS M. and MISS F....New York.
EISENBERG, RALPH M.....Carbolineum Wood-Preserving Co., New York.
EMERSON, MRS HARRINGTON.New York.
ERICSON, MRS. L. T.....New York.
FISHER, WM. C.....Salesman, Carbolineum Wood-Preserving Co., New York.
FISHER, MRS. WM. A.....Bound Brook, N. J.
FULKS, MISS MARION W.....Chicago, Ill.
FULWEILER, MRS. W. H.....Philadelphia, Pa.
GENET, JOSEF.....Consulting Engineer, New York. (Stockholm, Sweden.)
GILMORE, JOHN P.....Salesman, Taylor Instrument Companies, New York.
GOEBEL, WM. H.....Treating Inspector, Erie R. R., New York.
GOLDSTEIN, MRS. C.....Philadelphia, Pa.
GOODSELL, D. B.....Assistant Engineer Highways, Brooklyn, N. Y.
GOSLINE, MRS. C. E.....Boonton, N. J.
GRIFFIN, E. B.....Engineer, American Telephone & Telegraph Co., New York.
GURTLER, F. H.....Official Stenographer, Chicago, Ill.
HANDY, GEO. F.....Assistant Engineer, N.Y.,N.H.&H.R.R., New Haven, Conn.
HARRIS, T. S.....Vice-President, Kettle River Co., Minneapolis, Minn.
HENDRICKS, MRS. V. K.....St. Louis, Mo.
HERT, J. A.....Superintendent, Federal Creosoting Co., Bound Brook, N. J.
HILBERT, E.....Dencker & Co., New York.
HILL, NAT. M.....Engineer, Troombly & Heeny, New York.
HOLLAND, B. E.....Superintendent Ayer & Lord Tie Co., Tie Plant, Ark.
HOLLAND, MRS. B. E.....Tie Plant, Ark.
HOWE, MRS. G. H.....New York.
HOYT, MRS. H. B.....Bradford, Pa.
HUB, C. M.....“American Lumberman,” New York.
HUBBARD, C.....Foreman, Port Reading Creosoting Plant, Port Reading, N. J.
ILIFF, W. L.....Hyatt Roller Bearing Co., Newark, N. J.
INGALLS, EDMUND E.....Student, Yale School of Forestry, New Haven, Conn.
JAEGER, F.....Carbolineum Wood-Preserving Co., New York.
JAMES, E. L.....“Times,” New York.
JOHNSON, MRS. J.....Loraine, Wyo.
JOYCE, MRS. A. R.....Chicago, Ill.

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JULIER, JOSEPH.....Joyce-Watkins Co., New York.
KAMMERER, MRS. LAURA E...St. Louis, Mo.
KEAST, H. C.....Assistant to Forester, Pennsylvania R. R., Philadelphia, Pa.
KINGSLEY, F.....Associate Editor, "Electric Railway Journal," New York.
KIEFF, MRS. HELENE.....New York.
KRUSE, R. F.....Southern Representative, Carbolineum Wood-Preserving Co., New York.
LEAVITT, CLYDE.....Forester, Conservation Commission of Canada, Ottawa.
LEWIS, MRS. W. H.....Chicago, Ill.
LITTLE, J. G.....Editor, Simmons & Boardman Publishing Co., New York.
LITTELL, W. B.....American Forestry Association, Washington, D. C.
LOVETT, A. G.....General Manager, Mogul Co., New York.
LUCAS, F. F.....Engineer, Western Electric Co., New York.
MAY, H. W.....Engineer, American Telephone & Telegraph Co., New York.
MAN, ANDREW M.....Salesman, Carbolineum Wood-Preserving Co., New York.
MATTOS, MRS. F. D.....Oakland, Cal.
MAURER, HENRY W.....Vice-President, Taylor Instrument Companies, Rochester, N.Y.
McCORMICK, J. A.....Secretary & Treasurer, Charleston Engineering & Contracting Co., Charleston, S. C.
McILRAVY, W. N.....Vice-President, The Barrett Co., New York.
McILRAVY, MRS. W. N.....New York.
McSHIED, E. PAUL.....Consulting Engineer of Stockholm, Sweden, New York.
MILLER, EDWARD E.....Carbolineum Wood-Preserving Co., New York.
MOSES, MISS ROSA G.....Minneapolis, Minn.
MUSSELMAN, C. B.....Treating Inspector, Lehigh Valley R. R., Bound Brook, N. J.
NAYUDU, G. K.....Assistant Conservator of Forests, Bangalore, Mysore, India.
OSBORNE, CLYDE.....Superintendent, Ayer & Lord Tie Co., Carbondale, Ill.
PHILLIPS, CHAS. A.....Principal Engineer, Port Reading Creosoting Plant, Port Reading, N. J.
POOLER, MRS. F. S.....Evanston, Ill.
RABOURN, MARION M.....Treating Inspector, C. & E. I. R. R., Evansville, Ind.
RABOURN, MRS. MARION.....Evansville, Ind.
ROBERTS, DR. G. W.....Vice-President, The E. T. Chapin Co., Spokane, Wash.
ROBERTS, MRS. G. W.....Spokane, Wash.
ROBISON, MRS. N. S.....Minneapolis, Minn.
ROCKWOOD, NATHAN C.....Associate Editor, "Engineering News," New York.
ROEHRICK, VICTOR H.....Director, Municipal Testing Laboratories, St. Paul, Minn.
RICHARDSON, CLIFFORD.....Consulting Engineer, Barber Asphalt Paving Co., New York.
SAUMS, GEO. W.....President, Geo. W. Saums Co., Plainfield, N. J.
SCHLUDE, JOHN N.....Secretary and Treasurer, Carbolineum Wood-Preserving Co., New York.
SHANESEY, MRS. M. T.....Ann Arbor, Mich.
SHEPPARD, CHAS. C.....Chemist, Port Reading Creosoting Co., Port Reading, N. J.
SMITH, H. H.....Salesman, Middletown, N. Y.
STAMFORD, MRS. ALBERT.....Norfolk, Va.
STELLE, GEO. D.....Editor, "Better Roads and Streets," Germantown, Philadelphia, Pa.
STEINMAYER, MRS. O. C.....Springfield, Mo.
STERLING, MRS. E. A.....Chicago, Ill.
STEVENSON, T. C.....President, Charleston Engineering & Contracting Co., Charleston, S. C.
STEVENS, MRS. C. N.....New York.
STEWART, FRANK, Jr.....Crumps Park, Ga.
STEWART, MRS. F. H.....Crumps Park, Ga.
STEWART, MISS CLAIR LEE...Macon, Ga.
STROHMEYER, CHARLES, Jr..Civil Engineer, Public Service Commission, Brooklyn, N. Y.
TAYLOR, G. M.....Cornell University, Department of Forestry, Ithaca, N. Y.
TAYLOR, MRS. C. M.....Elizabeth, N. J.
TOOMEY, E. H.....Secretary, S. P. F. Wood-Preserving Co., New York.
VAIL, REV. CHAS. H.....Brooklyn, N. Y.
VARIAN, ARTHUR.....Representative, Eppinger & Russell Co., New York.
VAUGHAN, T. S.....President, The Vaughan Paint Co., Cleveland, O.
WEISS, J. M.....Chief Chemist, The Barrett Co., New York.
WETHERILL, SAMUEL.....Salesman, Barber Asphalt Paving Co., Philadelphia, Pa.
WETMORE, WILLARD, C.....Representative, The Northeastern Co., New York.
WHITBECK, ROSS M.....Carbolineum Wood-Preserving Co., New York.
WOODHEAD, DANIEL W.....Sales Manager, Central Electric Co., Chicago, Ill.
WOODHEAD, MRS. D. W.....Chicago, Ill.
WRIGHT, GEO. D.....Vice-President, Consolidated R. M. & F. Co., Mexico City, Mex.
YOUNG, E. V.....Inspector, Dow & Smith, New York.

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## PROGRAM.

### TUESDAY MORNING.

Opening by Prayer.....Rev. Dr. Charles H. Vail
President's Address.....Carl G. Crawford
Report of Entertainment Committee.....Jesse I. Eppinger, Chairman
Report of Secretary-Treasurer.....F. J. Angier
Communications.

### TUESDAY AFTERNOON.

Report of Committee on Publicity, Promotion and Education, E. A. Sterling, Chairman
Report of Committee on Terminology.....J. B. Card, Chairman

### WEDNESDAY MORNING.

Report of Committee on Service Tests of Ties and Structural Timber, C. P. Winslow, Chairman
Report of Committee on Plant Operation.....A. L. Kuehn, Chairman
Report of Committee on Preservatives.....E. B. Fulks, Chairman
Discussion of Report of Committee on Preservatives.....Wm. A. Fisher
Discussion of the Paving-Oil Specifications Proposed by the Joint Committees of the American Society for Testing Materials, American Society of Municipal Improvements, Southern Pine Association, American Society of Civil Engineers and the American Wood-Preservers' Association.....Ernest Bateman
Discussion of Report of Sub-Committee B of Committee on Preservatives, Ellis R. Dutton

### WEDNESDAY AFTERNOON.

The Bad and the Good in the Handling of Wood, J H. Waterman and George E. Rex
The Grouping of Ties for Treatment.....C. P. Winslow
Report of Committee on the Purchase and Preservation of Treatable Timber.....A. R. Joyce, Chairman
Discussion of Report of Committee on the Purchase and Preservation of Treatable Timber.....F. S. Pooler
Seasoning Timber.....R. H. Rawson
The Tie Supply.....O. C. Steinmayer

### THURSDAY MORNING.

Report of Committee on Service Tests of Wood-Block Paving, L. B. Moses, Chairman
Report of Committee on Wood-Block Paving.....C. H. Teesdale, Chairman
Appendix to Report of Committee on Wood-Block Paving, C. H. Teesdale and John A. Newlin
Report of Committee on Resolutions.....Wm. A. Fisher, Chairman
Election of Officers.

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## SESSIONS.


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| Tuesday Afternoon..... | 49 |
| Wednesday Morning..... | 82 |
| Wednesday Afternoon..... | 369 |
| Thursday Morning..... | 431 |


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## OPENING SESSION.

The Thirteenth Annual Meeting of the American Wood-Preservers' Association, held at Hotel Astor, New York, January 23, 24, 25, 1917, was called to order by its President, Mr. Carl G. Crawford, Tuesday morning, January 23, at 10.30 o'clock.

THE PRESIDENT: Ladies and Gentlemen: The Thirteenth Annual Meeting of the American Wood-Preservers' Association is now called to order. We will be led in prayer by Dr. Vail.

REV. DR. CHARLES H. VAIL: Let us invoke the Divine blessing.

Oh Thou Eternal One, whose presence fills all space and occupies all time and who has thy dwelling place in every humble heart that trustingly looks up to Thee. We assemble here, Heavenly Father, at the beginning of this convention, feeling our need and dependence upon Thee as the giver of every good and perfect gift. We would ask, oh God, that Thou would be with the deliberations of this Association; that they may feel in the work they are doing that they are helping to make this world a better and more economic world in which to live; that we are co-workers with Thee, and that in their efforts to preserve the natural elements of nature, in their efforts to preserve the wood about us that they are indeed co-workers with Thee. And so we would feel indeed that we can ask Thy blessings upon this meeting here assembled. Be with its deliberations, be with the officers, oh God, and members that are here assembled and give them Thy spirit as Thou sees they may need, and help them to feel in all these things that they are working in harmony with Thee, that they are helping to advance civilization, that they are building up indeed those things that shall work for righteousness, and thus they are laying foundations for a noble humanity.

Be with us and help us, Heavenly Father, we will pray for the forgiveness of all our sins of omission and commission. Lead us by Thy spirit, keep us ever in Thy way and in Thy will. Again, our Heavenly Father, we would commend unto Thee the members of this Association; be with them in the days in which they shall convene here. Help them, our Heavenly Father, to be guided by Thy will and thus feel, indeed, that what is done may be done in Thy spirit and in Thy name and may be done for the bettering and uplift of the world. Thus they may be, indeed, co-workers with Thee in the affairs of Thy Kingdom. At last bless us and save us all, we would ask in Thy name and Thy spirit. Amen.

THE PRESIDENT: The next is the minutes of the last meeting. These have been published and placed in your hands, and we will dispense with reading of the minutes, unless they are called for. If there is no objection these minutes stand approved. They are approved.

The President then addressed the meeting as follows:

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## PRESIDENT'S ADDRESS.

*To the Members of the American Wood-Preservers' Association:*

When you revised our Constitution at our last annual meeting you did not make it obligatory upon your President to deliver an annual address. But in considering the position of your President and the Executive Committee, and their opportunities for studying conditions and needs of the Association during the year in which they administered its affairs, I felt that it might be well worth while to take a few minutes at the beginning of this meeting to address you, with the hope that I might be able to say something that would help to strengthen the Association and better its condition.

After having served a year as your President I realize more fully than ever before that your President and Executive Committee, if they feel the responsibility placed upon them, and do the work required by the Association in order to make more firm its foundation, raise its standard, stimulate its growth and strengthen its purpose in promoting the industry, as your administrative officers must necessarily make a careful study of the history of the Association from its beginning together with its present status, with careful regard for the work it is now doing and the work it is to do in the future. This study of conditions which they are compelled to make places your President and Executive Committee on vantage ground more favorable perhaps than that of other members for observing the difficulties and needs of the Association.

Therefore, it might be well at this time to call to the minds of the members the growth of the Association in the past, its present position with regard to the industry, and the place it occupies with other industries and their official organizations, that we may obtain a better insight into the future and see the needs of our Association and the work to be done to strengthen and better it. I shall, therefore, recite briefly the history of this Association up to the present time, and try to point out as I do some of the difficulties it has had to overcome.

This Association had its inception at Perth Amboy, N. J., in March, 1904, at a little meeting of less than a dozen men engaged in wood preservation. Those men, of whom your President was one of the number, gathered there for the purpose of witnessing some tests in trying out one of the modern processes which was then being exhibited for the first time in this country, and is now one of the leading processes in use. There were present at this meeting men who were the oldest operators in the industry, some of whom have since passed away. It was stated by them that, to their knowledge, there never had been so many men engaged in the industry gathered together at any one time as there were at this small meeting, and I can say to you gentlemen

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here today that that was about the livliest meeting of Wood-Preservers I have ever attended in my life. Each man held a different view as to the best way to treat timber, and each was equally positive that he was right. Discussions were frequent, continuous and heated.

It was there decided that those engaged in the industry should get together frequently in the future and discuss the best methods of preserving timber and other problems which might help to promote the industry. There was a meeting during that summer at the World's Fair in St. Louis, and this Association was organized with its first annual meeting to be held in New Orleans in January, 1905. There have been altogether twelve annual meetings, and we are now assembled for the thirteenth. The first of these meetings were stormy. Discussions during the meetings and between members when the Association was not in session were heated, and often incurred much illwill. Each member seemed to feel that his own wonderful knowledge of the art was being doubted and that something might be said, or some steps taken, that would greatly injure him or his company. Others seemed to take the position that they must have their own ideas of the art and the methods employed by them and their companies endorsed at these meetings, if they expected to remain in the industry. It can easily be seen by those here today that methods and processes in wood preservation involve such deep technical points that it is little wonder it was hard to reconcile these differences of opinion at that time, even when members were honest in their convictions and advanced their opinions solely for the good of the Association and the profession. But when selfish ulterior motives were at the foundation of their actions it is little wonder that the members could not reach conclusions or come to any definite decisions in their work. And as a word of encouragement let me say that this element, sometimes referred to as "commercialism," was much more prevalent during the early days of the history of this Association than it has been in later years. Perhaps this difficulty of certain members working for special interests and attempting to use the Association in their behalf has been the greatest one that this Association or any other association representing its industry has had to overcome—if we have yet overcome it. This difficulty was so great during the early days of the Association that for a number of years little or no attempt was made to prepare programs which would bring up technical points, and perhaps the first half dozen annual meetings were held with the idea of merely promoting good fellowship among its members and having a good sociable time.

I have recalled this bit of our Association's history more as a defense for our present position in not having advanced further during the twelve or thirteen years the Association has been in existence, than for any other purpose. For the last half dozen years, however, the history of the Association has been different. The membership has

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grown rapidly. The field has become broader and men of new ideas have been brought into the Association. Technical problems have been discussed and without any serious consequences, and a little later in this address I hope to point out to you some of the achievements we have accomplished of which we are proud. But before doing this I would like to consider with you a few points which appeal to me as measures that will add strength and purpose to our Association, and I hope in doing this I am also voicing the thoughts of the rest of the members of the Executive Committee.

During the year I have observed that there is a lack of proper spirit and loyalty on the part of many members of the Association. In fact, I may say, all the members of the Association, for in speaking of loyalty I refer more particularly to the lack of unity or individuality due to lack of loyalty which our Association should possess in order that it may take its proper place as the official organization of our industry among the official organizations of other industries. It might be said that this Association in the past has not commanded the respect and confidence which it should have commanded. There is no industry in our country that is so far reaching and which affects the welfare of society and our government in protecting its natural resources as that of wood preservation. Therefore the industry should have and must have an organization which is representative of the value and prominence of the industry, which will give the industry the proper backing and serve as a mouthpiece whenever our rights are invaded. The industry will greatly suffer without such an organization.

How can we best build up this Association and give it the strength and create the confidence it deserves? I believe I have already touched upon the most vital point, which has been the means of holding it back, namely, too strong an element of commercialism, the lack of unity and individuality, too wide a divergence of opinion and the failure of some to see that the very best way to promote their own private position and business is to bend every effort to build up an organization in the industry which will demand the respect and confidence of every other business. So long as members come to these Association meetings with the idea of using them in a way which will sacrifice the best interests of the Association in order to bring quicker and greater returns to their own business, if such still is the case, so long will our Association fail to take the place it should. Whenever our Association acquires that strength of unity and individuality and creates a spirit of loyalty and self-pride which will give it sufficient strength to cause any member or individual to tremble with fear of bringing down upon himself righteous indignation whenever he starts promoting any plan or idea which will weaken the Association rather than strengthen it, just as much as though he had insulted an individual, then this difficulty will have been forever removed from this Association.

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Perhaps next to this point a feature which will help to build up our organization is a better appreciation of the value such an organization as I have described will have on the industry and in each and every individual business. Rather than quibble among ourselves in the industry as to just who shall control this or that piece of business if we look to promoting wood preservation in its truest sense and drawing the attention of those using forest products to the great economical advantages gained by having a larger part of their products chemically treated, and thus make them serve their greatest length of life, each business organization represented in this Association will derive a greater profit.

There is also a tendency on the part of those engaged in the operation of treating plants for railroads who own their own plants, to believe that this organization cannot be of any great value to them: that it can be only of advantage to those engaged in the commercial end of the field, and that it rests with them to provide the technical information for the industry. I certainly am not in sympathy with this view, and I hope that I may be counted among the majority of the members of this Association in taking this stand. When any department of a railroad takes the stand that it needs no outside help or is not called upon to cooperate with other men or organizations representing the same profession, that department is likely to become a weak and sickly one in that railroad and the entire railroad is going to suffer from such a policy.

Therefore, gentlemen, you and your business are bound to derive a greater benefit from this organization when it is given the strength and standing it deserves than from any other means that you by your efforts can inaugurate and build up. When you deride or belittle this Association you are doing more to injure your own personal standing and that of your business than you can by any other step you may take. Let us as members of this Association get a true appreciation of its value before us and when we do that I will have no fear that others in other lines of industry will gain the same high appreciation of our value, or that we will be enabled to defend it and over-ride any obstacle which may be placed in our path. By gaining this view of our own value and working together with the hope of placing the Association on the plane on which it belongs, we will wipe out any lack of harmony or lack of unity which has existed in the past.

Gentlemen, let me say that I would rather attack a man with all the implements of modern warfare in his hands, if he lacks pride in himself as a man, or has no self-respect, than I would a man with bare hands, but who has a strong sense of loyalty to himself; one who becomes doubly incensed when his rights are invaded; one who is possessed with a spirit of pride and a right of defense when the most noble aims he possesses are frustrated. As it is with an individual,

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so it is with a collection of individuals or an organization. And I would rather see this organization possessed with a proper spirit of loyalty and self-esteem, if I wished to gamble on its success, than to see it possessed of all the rules or concrete methods known to mankind for overcoming its difficulties.

There has also been a spirit of discouragement manifesting itself at times recently in the past. As it became necessary for our officers and committeemen to encounter some of the difficulties which I have just mentioned they became discouraged, and felt that these difficulties could never be removed, and at times have seemed to lose hope of accomplishing through this organization the work which they have been asked to do. Your Executive Committee has had to deal with many of these perplexing problems this year and to do all they could to encourage and stimulate to their greatest efforts the members in whose hands work has been entrusted. It is because of these perplexing problems with which we have had to deal that I have seen fit to address you on the subjects which I have brought up this morning. Your Executive Committee is now placed in the position that in order to carry on more constructive work it must adopt more stringent rules and methods in order to deal with these difficulties, or you yourselves as members must furnish sufficient strength and backing as an Association to overcome them. It is the sense of the Executive Committee that as we restrict action and freedom, either in presenting our programs or promoting discussions, we thereby weaken our organization and hinder its growth. Therefore, it has been with the idea of preventing such action by the Executive Committee that I have pointed out to you this morning the foundation of these difficulties with a possible means of overcoming them. From what I have already said I would not have you get the idea that the history of this Association has been merely one of difficulties and drawbacks without accomplishments. These difficulties and hindrances have been pointed out to you merely with the idea of overcoming them, and to assure you that we can overcome them I merely need to mention the accomplishments we have already attained.

During the greater part of the past in the life of this Association it did little or no constructive work. It considered and deliberated over methods and processes in use rather than created anything of its own. This to my mind is one of the reasons why the Association has not gained greater strength and made more rapid growth. Constructive work, however, has been started, the foundation having been laid a few years ago when the policy of appointing committees to work on certain subjects was adopted. This year these committees have been assigned definite work in which they were to construct forms, methods and specifications to be adopted and recommended by the Association for publication in a MANUAL OF RECOMMENDED PRACTICE. I have reason to believe that these committees, at least most of them, have worked hard

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upon this task, and that they have prepared for this meeting methods, processes and specifications which, if adopted and recommended by this Association, will do more toward standardizing these methods and processes and doing away with many of the difficulties of the industry than anything that has ever been done by this Association in the past.

In September, 1916, a meeting of representatives of practically every industry in the United States interested in wood preservation was held in Brooklyn, N. Y., for the purpose of considering standard methods and specifications. Representatives from the following Associations were present: American Wood-Preservers' Association, American Society for Municipal Improvements, American Society for Testing Materials, American Society of Civil Engineers, American Railway Engineering Association and Southern Pine Association, and the representatives of these associations, after carefully considering the work of our committees, agreed to recommend to their organizations for adoption, with slight modifications, the reports prepared by our committees as you will have them presented to you here at this meeting. Some of these associations have already met and adopted these reports. This should cause every member of our Association to feel proud of our organization and the work we are doing. Furthermore, this should cause us to give greater consideration to the reports of our committees as they will be presented to us, for we all know how vital it is to arrive at some standard and have it adopted in our industry.

While we want the fullest consideration given to each one of our committee's reports and the very best methods and specifications worked out before their adoption by this Association, I hope our members at this meeting will give due consideration to the fact that our committees were chosen with the idea of having in them the very best talent our Association affords for each particular line of work, and that these men have given a year of hard study and thought in the preparation of these reports. Therefore, any changes which may be suggested should be given mature consideration and if possible receive the approval of the committeemen who have the work in charge. I would also like to call your attention to the fact that instructions were given our various committees to prepare and recommend to the Association plans and specifications to be adopted by the Association and published in a MANUAL OF RECOMMENDED PRACTICE, which we expect to publish after the adoption of these reports at this meeting. This places a responsibility upon the members gathered here at this meeting, which is perhaps greater than that resting upon any meeting in the past, and I hope you will accept this responsibility and give to the Association your loyal and very best efforts in performing this work.

In the organization of our committees and work for this year it was decided to divide the Executive Committee into two branches,

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one branch having charge of the financial and business end of the work and the other branch put in charge of our publications, our program and all educational work. This plan has worked out successfully. In the Secretary-Treasurer's report you will have placed before you the status of the business end of the Association. The program which will be presented at this meeting will give you an idea of the work of the educational branch of the Executive Committee. Each one of you has received during the year our magazine known as WOOD-PRESERVING, and can judge for yourselves the advancement made in this publication.

Because of the obscurity and difficulty in finding information contained in our ANNUAL PROCEEDINGS, and because of our slowness in starting a MANUAL OF RECOMMENDED PRACTICE, it was thought best this year to prepare and publish some ready available information under the title of HANDBOOK, to serve the needs of the industry. This has been done and the volume has recently been placed in your hands. The material contained in this HANDBOOK is merely the history of the industry and ready information concerning present practices, which may serve the industry until we have a book of recommended practices with the stamp of approval of the Association placed upon it, which, of course, will require years to prepare. This HANDBOOK was published with the idea that it would be revised and added to periodically. This one is only a start. However, we hope that it meets with your approval.

If you will kindly consider the work of the Association this year in the advancement made in our publications, and in the work of the various committees, which will result in the publication of the MANUAL; the recognition accorded us by other associations, tending toward the adoption of standards in our industry; the constructive work which has been done; the harmony and good spirit which has prevailed; all of which tend toward placing our Association upon a higher plane; I believe that we have cause for much encouragement and a feeling of pride and confidence in this organization.

In conclusion I would like to direct your attention to the work of your Executive Committee which you placed in charge at your last annual meeting. To my knowledge there has not been one word of dissension among the members of the Committee this year. Each man seemed to see his duty and did it, and if I had the time to point out the work done by each member I am sure in most instances it would solicit your hearty applause. They have supported your leader in every instance and have cooperated in a way that has been highly gratifying. I say this because it was you who placed them in their present position and should know something of the work they have performed. Neither your President nor the Executive Committee has accomplished all that they set out to accomplish this year, but we hope that sufficient

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work has been done to solicit from you some praise, but better yet to have inspired in you a higher regard for your Association and help you promote the unity and loyalty necessary to keep this Association climbing rapidly on the path upward. Gentlemen, I thank you (applause).

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THE PRESIDENT: Right here we wish to slightly change the order of the program for this forenoon. We are very glad to have the ladies with us, and the rest of the forenoon's program may be somewhat dull to them, in view of the fact that it is more or less of a business nature. Before they leave I want the Chairman of the Entertainment Committee to come forward and make his report, in order that the ladies may hear and know what entertainment has been provided for this meeting. Mr. Eppinger.

MR. J. I. EPPINGER: Ladies and Gentlemen and Mr. President: I have very little to say, as the Committee at its last meeting requested that the less said the better. They thought we would better put everything in print, and then there would be no misunderstanding. Therefore, there has been printed a program to which I call your attention, and would ask the ladies, especially, to watch the time mentioned on the program for meeting, as it is most essential that the busses start early that they may complete the trips laid out. Therefore ladies, we request that you be kind enough to be at the entrance at 45th Street at the times named.

Ladies and gentlemen, this evening there is to be a theater party, and tickets may be had on application to the Secretary. Tomorrow evening the banquet, and, by the way, although it is named banquet—banquet does not mean that you are to come in dress clothes. Any gentleman appearing in glad rags will be properly taken care of (laughter); if he needs the rags to go home with he is liable to go without them. Therefore, gentlemen, please take notice. It is also requested that the gentlemen requiring tickets for the banquet tomorrow please make application early that the necessary arrangements can be made. At the banquet, we are pleased to state, there is somewhat of a surprise in store for the gentlemen attending. The Committee trusts that you will all have a good time and hopes that in the near future you will be with us again (applause).

THE PRESIDENT: We will now have the Secretary-Treasurer's report.

## ANNUAL REPORT OF THE SECRETARY-TREASURER.

*To the Members of the American Wood-Preservers' Association:*

GENTLEMEN: Your Secretary-Treasurer begs to submit herewith his Annual Report for the year 1916:

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| | | |
|---|---|---|
| Cash on hand December 31, 1915 | | $766.40 |
| **RECEIPTS.** | | |
| Initiation fees | $389.95 | |
| Membership dues | 2,598.66 | |
| Advertising—Proceedings | 911.33 | |
| Advertising—Wood-Preserving | 833.53 | |
| Subscriptions—Wood-Preserving | 183.00 | |
| Sale of Proceedings | 187.38 | |
| Sale of Handbook on Wood Preservation | 71.75 | |
| Interest on bank deposits | 34.25 | |
| | | 5,209.85 |
| Total cash balance and receipts | | $5,976.25 |
| **DISBURSEMENTS.** | | |
| Reporting and printing 1916 Proceedings | $2,580.04 | |
| Postage, express and telegrams | 316.16 | |
| Office supplies, stationery, printing, clerical and stenographic work | 919.19 | |
| Expenses incurred at 1916 Meeting | 237.35 | |
| Printing invitations, programs and badges | 113.39 | |
| Subscriptions to periodicals | 5.00 | |
| Expenses of Committees | 35.07 | |
| Refund for initiation fee | 10.00 | |
| Refund for Proceedings | 3.50 | |
| Membership in Chamber of Commerce of U. S. A. and National Conservation Congress | 16.00 | |
| Expenses of Wood-Preserving | 1,325.58 | |
| | | 5,561.28 |
| Cash on hand December 31, 1916 | | $414.97 |

**"WOOD-PRESERVING"**

(For the Calendar Year 1916).

| | | |
|---|---|---|
| **RECEIPTS.** | | |
| Subscriptions | $183.00 | |
| Advertising paid in 1915 | 142.32 | |
| Advertising paid in 1916 | 578.47 | |
| Advertising (1916) outstanding | 353.78 | |
| | | $1,257.57 |
| **DISBURSEMENTS.** | | |
| Printing (four issues) | $904.74 | |
| Salaries, Editor and Stenographer | 301.60 | |
| Postage | 50.28 | |
| Stationery and supplies | 68.96 | |
| | | 1,325.58 |
| Deficit | | $68.01 |

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## Membership.

| | | |
|---|---|---|
| Last annual report | | 276 |
| Elected during 1916 | 41 | |
| Resigned | 12 | |
| Dropped for non-payment of dues | 6 | |
| | — 18 | |
| Total net gain | | 23 |
| Membership December 31, 1916 | | 299 |
| Corporate | 234 or 78.2% | |
| Associate | 51 or 17.1% | |
| Probate | 9 or 3.0% | |
| Honorary | 5 or 1.7% | |
| Total | 299 | 100% |

## Growth of Membership.

| Year. | New Members. | Withdrew. | Added to Roll. | Total. |
|---|---|---|---|---|
| 1904 | 20 | .. | 20 | 20 |
| 1905 | 7 | .. | 7 | 27 |
| 1906 | 9 | 7 | 2 | 29 |
| 1907 | 15 | .. | 15 | 44 |
| 1908 | 5 | 4 | 1 | 45 |
| 1909 | 13 | 12 | 1 | 46 |
| 1910 | 29 | 8 | 21 | 67 |
| 1911 | 45 | 8 | 37 | 104 |
| 1912 | 59 | 6 | 53 | 157 |
| 1913 | 37 | 11 | 26 | 183 |
| 1914 | 92 | 10 | 82 | 265 |
| 1915 | 29 | 18 | 11 | 276 |
| 1916 | 41 | 18 | 23 | 299 |
| Total | 401 | 102 | 299 | |
| Average for 13 years | 30.8 | 8 | 23 | |

## Distribution of Members.

| | | Members |
|---|---|---|
| 37 | Railroads | 79 |
| 1 | Navigation company | 1 |
| 46 | Commercial treating plants | 99 |
| 16 | Tie and lumber companies | 17 |
| 24 | Chemical and manufacturing companies | 38 |
| 2 | National Governments | 7 |
| 4 | Educational institutions | 6 |
| 7 | Municipalities | 8 |
| 2 | Periodicals | 2 |
| 4 | Associations | 7 |
| 6 | Firms not classified | 8 |
| | Consulting engineers, chemists, etc | 27 |

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**Geographical Distribution.**

| STATE | 1914. | 1915. | 1916. |
|---|---|---|---|
| Alabama | 4 | 3 | 3 |
| Arkansas | 5 | 4 | 3 |
| California | 5 | 6 | 6 |
| Colorado | 3 | 2 | 2 |
| Connecticut | 1 | 1 | 1 |
| District of Columbia | 4 | 4 | 4 |
| Florida | 4 | 3 | 3 |
| Georgia | 2 | 5 | 5 |
| Illinois | 35 | 41 | 41 |
| Indiana | 6 | 8 | 10 |
| Iowa | 2 | 1 | 1 |
| Kansas | 4 | 4 | 4 |
| Kentucky | 7 | 8 | 8 |
| Louisiana | 10 | 12 | 13 |
| Maryland | 5 | 5 | 7 |
| Massachusetts | 2 | 3 | 3 |
| Michigan | 2 | 3 | 5 |
| Minnesota | 9 | 10 | 12 |
| Mississippi | 3 | 3 | 3 |
| Missouri | 12 | 12 | 15 |
| New Jersey | 7 | 6 | 7 |
| New Mexico | 3 | 3 | 3 |
| New York | 21 | 24 | 28 |
| North Carolina | .. | 1 | .. |
| Ohio | 11 | 12 | 12 |
| Oregon | 7 | 5 | 5 |
| Pennsylvania | 14 | 12 | 12 |
| Tennessee | 3 | 2 | 2 |
| Texas | 17 | 13 | 14 |
| Virginia | 3 | 3 | 4 |
| Washington | 16 | 17 | 18 |
| Wisconsin | 8 | 9 | 12 |
| Wyoming | 3 | 3 | 2 |
| | 240 | 251 | 272 |
| COUNTRY. | | | |
| Austria | 1 | 1 | 1 |
| Canada | 14 | 13 | 14 |
| England | 4 | 4 | 5 |
| Germany | 6 | 6 | 6 |
| India | 1 | 1 | 1 |
| | 265 | 276 | 299 |

It is worthy of remark that the increase in the membership has been due in a measure to our campaign of publicity, especially through our publications—the ANNUAL PROCEEDINGS, the quarterly magazine WOOD-PRESERVING, and the HANDBOOK ON WOOD PRESERVATION—which are creating greater interest in the wood-preserving industry.

A word of commendation should be said for those members who, though engaged in the world-war, have shown their loyalty by remitting their dues in order to maintain their good standing in this Association.

Respectfully submitted,

(Signed) F. J. ANGIER,
Secretary-Treasurer.

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MR. V. K. HENDRICKS: Your Committee appointed to audit the Treasurer's accounts has carefully checked same and finds the accounts to be correct. (V. K. Hendricks, Chairman, and J. H. Waterman.)

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THE PRESIDENT: Gentlemen, you have heard the Secretary-Treasurer's report. What do you wish to do with it?

MR. E. H. BOWSER: I move its adoption.

MR. W. F. GOLTRA: I second the motion.

THE PRESIDENT: It has been moved and seconded that the Secretary-Treasurer's report be accepted. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

THE PRESIDENT: I now wish to appoint our Resolutions Committee and I will appoint on that Committee Mr. William A. Fisher, Mr. C. M. Taylor and Mr. F. D. Mattos. I will appoint as election tellers, Mr. S. D. Cooper, Mr. W. C. Mills, Mr. L. B. Shipley, Mr. George Lembcke and Mr. H. I. Goldstein.

I wish to announce that you have the privilege of voting until noon today. All those who have not voted on officers for next year will please do so before that time. At noon the time for voting closes and the sealed ballots will be given over to the election tellers. They will make their report on Thursday.

The Secretary will make any further announcements that should be made at this time.

SECRETARY ANGIER: We have but one announcement; members of Committee No. 1 on Preservatives are requested to meet in Room M at 3 o'clock this afternoon.

THE PRESIDENT: Has anyone any other announcement to make that is of interest to the Association?

Gentlemen, we have decided to change the order of the program with reference to choosing the meeting place for our annual meeting. It has frequently happened in the past that when this was left to the last day and the last order of business that a great many of the members got away and we did not have a very representative audience to vote on this, and we think it is of sufficient importance that every member vote. Therefore, we have decided to have this occur on Wednesday before adjournment at noon. You will please bear this in mind. Of course, you understand that by our Constitution only Corporate Members are allowed to vote.

MR. W. H. GRADY: Mr. President, it seems that some of the members either lost their ballot or have not received any. Does the Constitution permit more than one ballot being issued?

SECRETARY ANGIER: You can get another one by applying at the Secretary's office before noon today.

THE PRESIDENT: The Secretary has some communications which he will now read.

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SECRETARY ANGIER: These are invitations from various cities to hold our 1918 meeting, and we vote on this, as the President said, tomorrow noon just before adjournment. St. Louis sends a very cordial invitation from the Mayor, the Merchants' Exchange and the Associated Retailers. We also have invitations from San Francisco; Asheville, N. C.; Buffalo, N. Y.; New Haven, Conn.; Asbury Park, N. J.; Providence, R. I.; and Chicago.

MR. NELSON C. BROWN: Mr. President, on behalf of the Mayor and Chamber of Commerce of Syracuse, N. Y., I extend a very cordial invitation to this Association to hold its next annual meeting at Syracuse. I want to add that invitation to the already long list of invitations. I could extol at some length upon the beauties and attractiveness of the hills and dales of Onandaga County and surroundings, but suffice it to say that we have all the advantages of Chicago and a few more. I thank you (applause.)

MR. V. H. ROEHRICK: Mr. President, in behalf of the City Council of the City of St. Paul, I would like to tell you that the last Saturday in January is the time of our famous Winter Sports Carnival, and if you have the next convention in St. Paul you will be there in time to take that in. It is well worth seeing. It far exceeds the Mardi Gras at New Orleans. If you can get up there next year the week before the last Saturday in January, why I am sure you will have a very enjoyable time.

SECRETARY ANGIER: Mr. President, I thought someone would mention New Orleans (applause.) I received a letter from Mr. Manley this morning, of which I will read a portion because some of it is confidential. He says:

> "I have started something which I cannot finish, that is, I proposed to all the members of the American Wood-Preservers' Association by circular letter, as you know, that they hold their next convention in New Orleans, and now at the last minute I find that it is absolutely impossible for me to leave New Orleans at this time to attend the convention of the American Wood-Preservers' Association. I have sent Mr. F. P. Hamilton, a representative of the Creosoted Materials Company, to the New York Convention, for the purpose of representing me there in the interests of New Orleans as the next convention city, and also to represent me in such matters concerning wood block specifications and so forth which may come up. I trust that if entirely consistent you will express my regret to the convention and state that Mr. Hamilton is representing me there in the interest of New Orleans, and further from that I should like very much to know that you will render him your active support."

MR. F. P. HAMILTON: Mr. Secretary, I thought we would hear from New Orleans before you got through. Most of you have been there. You know what New Orleans is. We have got more to offer to you than all these other places combined (laughter.) We hope to get your vote tomorrow.

THE PRESIDENT: Gentlemen, there seems to be no doubt but that we will have a place to meet next year. This ends our program for this morning. We are getting through a little early, but it

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will give you an opportunity to register, and those of you who have not voted to do so, and also to get your lunch and be back here on time. May I not urge all of you to make an effort to be at our meeting place here at the appointed time for each meeting? This is very necessary. It lends encouragement to the Association and gives those in charge of the work encouragement and help. Therefore, let me urge upon you to make an effort to be here promptly at 2 o'clock this afternoon, and at the same hour on succeeding days in the afternoon, and at 10 o'clock in the morning.

An adjournment was then taken till 2 o'clock P. M.

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## TUESDAY AFTERNOON SESSION.

**January 23.**

The meeting was called to order by President Crawford at 2 o'clock P. M.

THE PRESIDENT: We will now have the report of the Committee on Publicity, Promotion and Education, and I will ask the Secretary to read the names of this Committee, and as he reads them to have them come forward and take the chairs on the rostrum.

SERETARY ANGIER: Mr. E. A. Sterling, (Chairman), Mr. John S. Bates, Mr. Nelson C. Brown, Mr. F. P. Hamilton, Mr. E. T. Howson, Mr. S. J. Record, Mr. P. S. Ridsdale, Mr. C. C. Schnatterbeck, Mr. O. T. Swan.

MR. E. A. STERLING: Mr. President and Gentlemen: This report is very short and summarized in definite paragraphs, so I will read the whole thing.

## REPORT OF COMMITTEE ON PUBLICITY, PROMOTION AND EDUCATION.

*To the Members of the American Wood-Preservers' Association:*

The work assigned to Committee No. 7 falls under four distinct headings according to the instructions of the Executive Committee. Summarizing these as subject or chapter headings, we have: (1) Current Publicity, (2) Cooperation, (3) Educational Promotion, (4) Recommendations for future work.

Recommendations and procedure under the above headings as outlined are suggested as follows:

**1. Current Publicity.**

(*a*) That every member of the American Wood-Preservers' Association constitute himself a committee of one to talk and advocate the proper use of treated material wherever consistent with the requirements of the situation.

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(*b*) That individuals and companies furnish to their local newspaper interesting facts and information about the use of treated wood, this to include preliminary arrangements with the editors by pointing out the value and importance of the use of treated material in community development and permanence of structures. Then furnish interested editors with news items on new work, orders and inquiries for treated material, wood-block paving, and similar subjects.

(*c*) That more extensive advertising of treated timber is necessary and advisable, and that at comparatively small expense commercial wood-preserving companies, individually or as a group, could advertise in local newspapers.

(*d*) That commercial wood-preserving companies in or near universities or college towns arrange trips of inspection through their plants by the engineering students. Arrangements should be made as soon as possible, so that the inspection can be made during the pleasant autumn months.

(*e*) That the secretary of the Association circularize the members to ascertain those who will volunteer to give talks on wood preservation at nearby colleges and universities, and having obtained this list of volunteers work out a schedule and arrange with the schools for these talks and lectures, with stereopticon views and moving picture films if possible.

(*f*) That the attention of commercial wood-preserving companies be called to the possible development of treated highway bridges, and that they individually promote this use of treated wood by general publicity, and by propaganda among highway engineers and county highway commissioners.

(*g*) That the members of the American Wood-Preservers' be frequently and emphatically reminded of their obligations in furthering the interests of the industry.

(*h*) Adopt a slogan and give it publicity.

(*i*) Brand treated timber and advertise it.

2. Cooperation.

(*a*) That the officers and members of engineering and professional organizations, such as the American Society for Testing Materials, Amercian Railway Engineering Association, National Electric Light Association, and others, be furnished periodically with information about the work of the American Wood-Preservers' Association, and on the general subject of proper use of treated material, this information to take the form of brief, concise leaflets, and include solicitations for subscriptions to WOOD-PRESERVING.

(*b*) That a list be made up of enginering, professional and trade organization meetings during the fall and winter, and arrangements made for talks or addresses on some

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phase of wood preservation at these meetings, the members of the Association to volunteer to give these talks at the request of the secretary.

(*c*) That the many lumber associations, both manufacturers and retail, be kept informed of developments in wood preservation, the same as engineering and professional organizations, and that through the secretaries of these associations the members be solicited to subscribe to WOOD-PRESERVING.

(*d*) That a basis of cooperation be established with city engineers and highway commissioners to aid in promoting wood block.

(*e*) As a more definite form of cooperation in "Current Publicity" it is suggested that the American Wood-Preservers' Association cooperate with the National Lumber Manufacturers' Association especially along the lines of publicity in newspapers, engineering journals and lumber trade papers, on developments in wood preservation. The National Lumber Manufacturers' Association has a well organized news service, and will take rough news items, facts or information of any kind, put them into proper shape, and send them out with its regular news service which goes to over 5,000 newspapers and to practically all of the trade and professional journals.

(*f*) The Monthly Bulletin of the National Lumber Manufacturers' Association will carry one or two columns of wood-preserving news regularly if supplied by the American Wood-Preservers' Association in usable form.

**3. Educational Promotion.**

(*a*) As a broad educational propaganda the architect and engineer should be reached with information on wood preservation. Much of the information now available does not reach professional men who specify material, and when it does it is frequently not in the form which they can readily use.

(*b*) Over-lapping to some extent on the subjects above is the general education of retail lumber dealers on the use and possibilities of treated wood, they in turn being the important medium of education to the smaller consumer.

(*c*) Preparation and publication of articles on wood preservation in technical journals should be included in the broad educational work.

(*d*) Another educational feature, which is included in the above under "Current Publicity," because it should be carried on as a current project, is the lectures for the engineering students, and the trips of inspection through wood-preserving plants. A special course in wood preservation should be recommended at colleges and made a permanent educational feature.

**4. Recommendations For Future Work.**

(*a*) The future work of the Committee should consist largely in developing and carrying out the lines of

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publicity and educational activity which prove to be feasible and possible by a voluntary committee under an association which is handicapped by lack of funds. Experience will also determine the practicability of promotion effort by an association which is composed in part of non-commercial interests. The increased sale and use of the material which the organization represents, and greater knowledge of methods and results will follow from systematic publicity.

While the commercial plants are primarily interested in a general increase in the use of treated timber as a means of increasing output and sales, the managers of railroad plants also need the assistance of the Association in carrying to all railroad officials the necessity and advantages of extending the use of treated timber by railroads to all places where such use is consistent with the service required. It follows, therefore, that publicity and education are of value to all classes of members in the Association. The ends to be attained are the same, although the reasons for attaining them are radically different.

E. A. STERLING, *Chairman*
JOHN S. BATES
NELSON C. BROWN
F. P. HAMILTON
E. T. HOWSON
SAMUEL J. RECORD
P. S. RIDSDALE
CHAS. C. SCHNATTERBECK
O. T. SWAN

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MR. E. A. STERLING: Gentlemen, Paragraph "b" (page 50) covers a phase of our work that has been sadly neglected. The plants are all operating in or near community centers, towns and cities of various sizes. It is evident in any clipping service that wood preservation gets into the public press very rarely, yet you have very many interesting things going on which the editors would be glad to print. It is suggested here that you get acquainted with the editors and make arrangements in advance. This will be helpful, but perhaps not absolutely necessary. The most important phase of this, I think, gentlemen, is to give the papers real news, and under no circumstances attempt to put over something in the way of free publicity, because you will hurt your own game and you will not get it. There are some things in the way of actual newspaper news which they will be glad to use.

Paragraph "c" (page 50): The possibilities of local advertising have not been developed, and that perhaps to some extent at least ties up with the news service which you would get. Strictly speaking, there is no connection between advertising and news service, but since editors, wood-preservers and everybody else are human, personal contact and

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acquaintanceship go a long way It would be easier to get editorial comment and easier to get newspaper matter printed if the industry advertised locally and nationally, which it should do.

Paragraph "d" (page 50): This is a line which I understand has been developed to some extent through your Secretary, but no doubt could be carried a great deal farther. The average architect and engineer graduating from a university has little or no knowledge of wood preservation. He may hear an occasional lecture but one of the strongest educational factors would be for him to see with his own eyes how timber is treated, what it looks like, and talk to the men in charge of the plant.

Paragraph "e" (page 50): This could tie up very nicely with the preceding one. The talks would be a good introduction to trips of inspection, and arrangements could probably be made at the time with the man who gave the talk for an inspection trip through some nearby plant. There are a great many men in this audience, and as members of the Association, who can give interesting talks on the industry they represent, and it will be a very small thing for every man to give one, two or more days to talks of this kind. It would do them good and it would certainly do the students a great deal of good and help the industry. The stereopticon views and moving picture films I think are mentioned later on, but there are slides and films now available. Some of the railroads have moving picture films of their own plants. The Forest Service has various educational material of this kind, and it would be very easy, I think, for the Secretary or for the Association to obtain for permanent use a set of these slides and films.

Paragraph "f" (page 50): The question of highway bridges was brought up because it is a subject which has come to the fore during the last year or two. There is also some difference of opinion as to what the individual treating company managers do in promoting this. The natural assumption was that the local men have a local influence with their commissioners. At the same time that gets you into the realm of city or county politics which is not always a good thing to mix up in. However, we know that highway bridges generally are being built of materials other than creosoted wood. We also know at the same time that a creosoted highway bridge, properly designed and properly treated, is very good and very permanent, and it seems to me that this is an overlooked opportunity.

Paragraph "g" (page 50): This would be a sort of a followup proposition to keep us all reminded continually of what we might do to help ourselves and the business.

Paragraph "h" (page 50): It is just plain, everyday advertising sense, to have a slogan and to play it up before the people.

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Cooperation (page 50): That would be very lovely, and I hope it may happen sometime, but I am afraid you are not ready to talk details on it.

Paragraph "a" (page 50): In other words, this is just a matter of cooperation between the American Wood-Preservers' Association as one national body and other national bodies which are, generally speaking, consumers or potential consumers of treated material.

Paragraph "b" (page 50): In other words, we have occurring, as you know, now and for the next two or three months, and in fact back for some time, a great many meetings, technical, semi-technical, trade, professional and otherwise, and it is only by accident that the subject of wood preservation is presented It would be a big task to cover the whole field, it would probably require an organization somewhat different than this, but at the same time we have here an opportunity under proper guidance for the members to get out and talk at these various meetings.

Paragraph "c" (page 51): That is simply a specific phase of the subject which is covered under "b," and I might say incidentally that the lumber associations would be especially glad and especially interested to have more information on this subject. There have been a number of requests during the past two or three months for this very sort of thing coming to our Association, particularly from organizations and retail lumber dealers. They are not handling treated material to any extent. They know there is such a thing. They would like to know more about it, and if the men were only available either from this Association or elsewhere, we could put before the retailers of the whole country the essential facts of the subject.

Educational Promotion (page 51): I want to say about those two subjects that all of you ought to be ashamed of yourselves. I do not think what I am going to say will do much good, because it has been said before and will probably have to be said a great many times again. Each one of you handles over his desk and in his mail and in his every day business, facts and information which would make excellent publicity, around which and upon which good stories could be written for many classes of publications, and yet you sit and let those things go into your files or somewhere else, and they never get to your Secretary, they never get to the publicity organization you maintain as part of the Association, and they certainly do not get to the newspapers.

You are missing a very great opportunity. It goes without saying that you are not newspaper men and do not pretend to be, but you do not have to be. If you will shoot this information in, as a memorandum or in any form, rough as it may be, it can be whipped into shape by

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newspaper men and used. Why do you not do it? Probably first because you think of it today and you do not think of it again until somebody reminds you, and perhaps another reason is—and I hate to say this too—that wood-preservers, like men in a great many other lines, are afraid particularly of the other fellow.

You have an idea that you are going to give something away. You do not know just what harm it is going to do, yet you think it might do some harm, but I want to tell you publicity is the order of the day.

If you have any items on business, any items of paving or items on bridge work, or a hundred and one other things, do not be afraid that your competitor will get hold of them. Supposing he does? It is going to help the whole game along. You cannot do any better than to start sending in to your Secretary all sorts of information of this kind that you get. You have among other things, the offer from our organization to devote some space in their Bulletin to this subject if you will only send us the material.

Paragraph "a" (page 51): A lot could be said about that. I am going to touch on one phase of it. For many reasons architects are advocating more mill construction buildings this year, and will plan more in the future than have been put up for a great many years. There is a wave of enthusiasm for mill construction going all over the country in connection with this cooperative movement, the character, kinds and grades of lumber to use, the question of its durability. There are a number of cases of failure of roofs, and when the architects come to consider these things how many of them think or know anything about wood preservation as a partial solution. That is the trouble. Hardly any of them know. A man may know a little something about it, but he is handicapped everywhere because the treating plants themselves do not help him any, there is no definite information on the subject, and he simply throws up his hands and gives it up as a bad job. There is a distinct commercial opportunity for developing the use of treated material which everyone of you should follow up.

Paragraph "b" (page 51): I touched on that in the heading farther back. There are a great many of these dealers who are interested in this. They would like to know more about it. They would like to handle treated material, if it were made possible for them to do so.

Paragraph "c" (page 51): That is a little different than the short news items which would probably have to be rewritten. All of you take your pen in hand once in a while and perpetrate something for WOOD-PRESERVING or in the PROCEEDINGS or in a report, but you could do a whole lot more. I am sure that the professional journals

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would be very glad to publish it. Incidentally, do you ever pick up an engineering journal and note the beautiful absence of anything about wood preservation? You who are running commercial plants will find your competitors are distinctly on the job. You will find their names on all the headlines, but you do not find very much about the use of treated material.

Recommendations for future work: In other words, this is mentioned under the two headings, because it is something that should be done as a current project and at the same time it is broadly educational.

(Mr. Sterling then concluded the reading of the report.)

MR. E. A. STERLING: That last paragraph brings up an apparent difficulty, and yet not necessarily an insurmountable one if handled rightly. I think I might add to what is said there that the railroads have almost as direct an interest in the general promotion of the use of treated material as the commercial plants, because it comes back to them through their Traffic Department, and through the possibility of greater tonnage. It is also one of the broadly educational things which tend to build up industries along their line, and you can start from the farmers with their treated fence posts right up through to the shipments of large material for large structures.

I will close by mentioning one point which I am afraid our Committee overlooked, and that is the possibility of developments in the educational propaganda through the Industrial Departments of railroads. Some of the railroads I understand already have moving picture films of their treating plants, most of them certainly have very live Industrial Departments interested in all phases of work of this kind, and it would seem a very easy thing to give those industrial departments the necessary information on which to spread the propaganda of wood preservation. I thank you (applause.)

THE PRESIDENT: Gentlemen, this Committee has outlined a plan that will do much towards building up and strengthening our Association. The same Committee, or a Committee under the same heading will be in force next year. I think it will be quite proper to devote this time to comments or criticisms whichever they may be, that will help this Committee in presenting a final report satisfactory to this Association. It is now in your hands.

MR. WALTER BUEHLER: I wonder if anyone here appreciates the real value of the suggestions made by this Committee. I want to give you a concrete example of the necessity of publicity, and this example may probably be a surprise to some of you.

I attended a meeting some time ago where they were discussing the relative value of timber versus concrete docks. Someone brought

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up the question of creosoting the timber in the timber docks. The chief engineer of a certain railroad was present and was expressing his opinion as to the relative life of concrete and timber docks. He said that a timber dock will have a life of from 12 to 15 years, and under certain conditions 8 to 10 years. The question was asked him, "If you treated the timber how much longer would the dock last?" He replied, "Oh, probably 2 or 3 years longer." That comes from the chief engineer of a railroad, and I claim when the chief engineer of a railroad displays this ignorance of the subject it is time for this Association to begin education along these lines. I therefore, want to make this motion that this Committee be thanked by the Association for its valuable suggestions and recommendations, and further that the Executive Committee be instructed to work out some practical plan whereby the Association may derive benefit from the recommendations and suggestions of this Committee.

MR. J. H. WATERMAN: I want to second that motion, and I want to speak to it just a minute. I do not know of any men that need education along the line of treated material any more than the railroad men of this country. That is a pretty broad statement, but I am here to back it up.

I know a man who is quite an enthusiastic treating man, and he received a letter from the vice-president of his railroad stating this: "I am glad you are enthusiastic, because I hope that through your enthusiasm more information will reach the officers of the railroad which you represent." I tell you they do not know very much about treated timber. The only way you can get it in their heads or get them to grasp it is to talk about it in season and out of season and all the time.

Another point I want to make is the question of treating posts. In the past three months at least half a dozen men have come to me in our town and have said, "How can we treat posts"? showing the public was wide awake. One was a farmer, I think two of them in fact, one was a banker, and the other man was a butcher. So you see they are all interested, if we can get the news or the facts to them.

THE PRESIDENT: Gentlemen, there has been a motion made and seconded. We will not vote upon this motion until you have had an opportunity to offer whatever comments or criticisms you may have to offer on this subject along with the discussion of this motion, if this is satisfactory.

MR. E. T. HOWSON: Mr. President, I would like to refer to this subject from a little different angle than most of the men in this Association see it, being more directly connected with the editorial side of the problem.

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Last spring when we saw that the price of steel was rising very materially, I wrote five or six members of this Association, to endeavor to secure discussions from them of the opportunities for mill construction for certain types of railroad buildings. We could not get the information from the men who had it so we were unable to give that subject any publicity.

Hardly a week goes by but what I receive the inquiry, "Can you use an article? We have located something interesting on concrete." I happen to be in the same city where the headquarters of the Concrete Association are. These manufacturers have an organization to put that information out. They advertise "Concrete for Permanence." They have a library of several thousand volumes and anybody who wants any information on that subject can get it from them in a minute. They have brought about co-operation between the manufacturers and that is the reason they are making inroads on timber.

The timber industry has an opportunity now that it has not had in recent years, yet we in the editorial line find it almost impossible to get information on timber. We do not get the co-operation of the men in the field who run across the interesting features. If we go out we can get them through our good friends in the timber field—but we do not have time to do all these things. The other folks bring the data to us. You will find no one in the editorial field, I am sure, asking for that information in order to fill their papers for they have more material than they can use. It is a process of selection, but at the same time they desire to maintain a balance in their papers. Those who are friendly to timber want information concerning it, but they cannot secure it alone. We have got to have the co-operaton of the men who have first-hand information and access to the facts. The opportunity is there. The extent to which it will be utilized depends on the extent to which the men of this Association co-operate.

MR. E. A. STERLING: Supplementing what Mr. Howson said, we checked up the material in a Christmas issue of one of the larger, if not the largest, engineering journals. We found eleven and a fraction column-inches relative to wood, that was both treated and untreated, and in the same issue there were 274 column-inches of competitive materials. That bears out what you say.

MR. F. J. ANGIER: Mr. President, for several years past we have, in co-operation with the Forest Service at Washington, compiled a report and printed in the PROCEEDINGS, which has been very instructive and interesting and a report that has been looked forward to by a majority of our members and others interested. I refer to the report entitled "Quantity of Wood Preservatives Consumed and Amount of Wood Treated by Wood-Preserving Plants in the United States."

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This report gives a summary of the wood-preserving plants, the consumption of preservatives, the progress of wood preservation in the United States and other valuable information. It also contains a comparative statement of the material treated in the United States showing the number of cubic feet of cross ties, piles, poles, paving blocks and other material and amount treated with creosote, zinc-chloride, zinc-creosote and other preservatives.

We have been quite fortunate in getting this information from a majority of the plants, but there are a few that for one reason or another withhold this information. To all such we have endeavored to assure them that the detailed information pertaining to their particular plant will in no way be divulged; that it will be treated strictly confidential. As the report shows, we simply print the totals of all plants showing the number of cubic feet of material treated and quantity of preservatives used. The individual reports are held under lock and key and no person outside of the one who gives the information is allowed to see it.

I hope with this explanation that all of our members and others who may be called upon to furnish this information will not hesitate to furnish it. Last year, I believe, the information was furnished from every plant but three, and one of these has just assured me they will furnish it, and I sincerely hope the others will do likewise.

THE PRESIDENT: Are there any further comments? Gentlemen, I feel that every person that has the good of the wood-preserving industry and this Association at heart—for in my opinion you cannot have the one without the other—should take a deep interest in this Committee's report, and should individually bend his best efforts in helping to put this Committee's recommendations into effect. If there are no further comments or discussions we will put the question still before the house.

MR. M. K. TRUMBULL: Mr. President, Mr. Kendrick stated before the Association at the annual meeting last year that the railroads of this country would be able to save from eighty to one hundred million dollars per annum by treating all their ties. This was exclusive of all other classes of forest products. As far as I have been able to observe this statement received no more publicity than its utterance at the annual meeting, and its publication in the PROCEEDINGS. It occurs to me that such an item is well worth dissemination and directly in line with the report of the Committee.

THE PRESIDENT: All those in favor of the question signify it by saying "aye"; contrary, "no." The motion is carried.

The Chairman of the Committee on Service Tests of Ties and Structural Timber is not here. He has forwarded by express a part

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of the material belonging to the report, but it has not reached here. Consequently we will have to defer this report until tomorrow. Therefore, we will pass on to the report of the Committee on Terminology, and I will ask the Secretary to read the names of this Committee, and they will please come forward as the names are read.

SECRETARY ANGIER: Mr. J. B. Card, Chairman, Mr. E. T. Howson, Mr. Geo. M. Hunt, Mr. G. B. Shipley, Mr. M. K. Trumbull.

MR. J. B. CARD: Gentlemen, I hardly think that we will have the time to take up every part of this report this afternoon. Therefore, we have decided to pass over some of it and take up the more important parts of the report first. If you will turn to page 76 you will see the heading, "Principal Processes used in United States." We are anxious to agree on a description of these processes in order to have them ready for the MANUAL at the earliest possible moment. Therefore, we will begin here. The first one under this heading is the Allardyce process, a description of which I will read.

We wish to take action on the description of these different methods of treatment, one at a time, so if any of you have any criticisms of these different descriptions we would be glad to hear the remarks at this time.

THE PRESIDENT: Gentlemen, you will understand that these terms and definitions have been prepared with the idea of having them adopted by the Association, and perhaps later published in the MANUAL.

MR. J. H. WATERMAN: What do you want, a motion to accept that paragraph?

THE PRESIDENT: Yes.

MR. J. H. WATERMAN: I move that the paragraph read by the Chairman of the Committee be accepted and adopted by the Association.

MR. WALTER BUEHLER: I second the motion.

THE PRESIDENT: It has been moved and seconded that the description of this process be accepted and adopted by this Association.

MR. A. R. JOYCE: Mr. President, this is a description of various methods of preserving timber. The last sentence reads: "The process is not in extensive use at present." It has nothing to do with the description of this particular method of treating timber. Do you not think it ought to be omitted? It is a comment. I would like to amend Mr. Waterman's motion that this description be adopted with the exception of that last sentence.

MR. J. C. WILLIAMS: I second the amendment.

THE PRESIDENT: Will the Committee approve of that recommendation?

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MR. J. B. CARD: Yes.

MR. J. H. WATERMAN: You can include that in the original motion.

THE PRESIDENT: In other words, the Committee approves that, and, therefore, we need not have the motion amended.

MR. A. R. JOYCE: I will second Mr. Waterman's motion as amended then.

MR. A. L. KUEHN: Mr. Chairman, I would like to ask if this motion means that this description is the recommendation of the Association as to the manner in which this process should be used? In other words, do we put our stamp of approval on this?

MR. J. CARD: These descriptions are simply definitions. They describe the manner in which the treatment has been done in the past and is being done at the present time.

MR. A. L. KUEHN: I think we have got to be careful to have it understood that this is not the recommendation of the Association as to the exact manner in which the process shall be worked.

MR. J. B. CARD: No, that is not the idea.

MR. A. L. KUEHN: I am afraid that is what your recommendation will come to if it is put into the MANUAL. This is the approved method and has the stamp of approval of the American Wood-Preservers' Association.

MR. J. B. CARD: I will read the first paragraph and that may make it a little clearer:

> In attempting to describe the various wood-preserving processes it is recognized that the details of the procedure followed may vary at different plants using the same process. In some cases the process has gradually changed in one or more details from that described in the original patent, but still retains its name. In the following descriptions the attempt has been made to give in as few words as possible the essential details of the various processes as used at present, without attempting a rigid definition. If any errors are discovered the Committee will appreciate having same called to its attention.

MR. J. H. WATERMAN: Mr. Chairman, we have to either accept one or the other. We have either to accept this definition of the Allardyce process, or we have to move an acceptance of it as a definition, and the way to treat ties or timber with this process. Now, what are we going to do?

THE PRESIDENT: Gentlemen, as I understand this, the instructions of the Executive Committee to this Committee were to prepare terms and definitions by which such treating plant equipment, treating plant operations and treating plant processes might be known. I take it that the work of this Committee is merely that of defining equipment, parts of equipment and processes and various terms in operation and not attempting to endorse those particular processes or parts of equipments or methods.

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MR. J. H. WATERMAN: Mr. Chairman, can I change my motion or withdraw it?

THE PRESIDENT: With the consent of your second.

MR. J. H. WATERMAN: I would like to make my motion read this way, that this organization accept this as the standard definition of this process. Then it is easy.

THE PRESIDENT: First I would like to know if the second will accept that change.

MR. WALTER BUEHLER: I will accept it.

MR. A. R. JOYCE: The second will accept the change with the last sentence left out?

MR. J. H. WATERMAN: They have erased the last sentence from it figuratively. They have cut that out.

MR. WALTER BUEHLER: This report comes under the head, "Report of Committee on Terminology." In the opening paragraph, instead of reading the one at the beginning of the processes, we find:

> Your Committee on Terminology was instructed to present for adoption at the annual meeting, for insertion in the MANUAL, terms of plant equipment and operation, also description of processes used in the United States.

I would suggest to the Chairman of the Committee and the other members, that it might be possible to put a sentence there that what follows is not intended to be recommended practice, but is merely set forth as what is understood to be descriptions and definitions best intended to cover the purpose.

MR. WM. A. CECIL: Mr. President, I think there is only one objectionable feature, and a few words that should be cut out, and that is the statement that the process is not in extensive use. The process is properly described just as it is.

THE PRESIDENT: That has been cut out.

MR. WM. A. CECIL: That is all, the process is properly described, and any process that has given good service should be left to the people to decide whether or not they will use that process. Just give a description and the description is the endorsement of the process, and let it stand as an endorsement, because the process is all right and all the processes that are used are good, everyone for the particular purpose. So I just say that we should give the description as it should go in the MANUAL, and that it is endorsed by this Association, provided the user wants to use that process.

THE PRESIDENT: Are you ready for the question?

THE MEMBERS: Question, question.

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THE PRESIDENT: All those in favor of the motion as put by Mr. Waterman, please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. L. B. MOSES: Mr. President, I would like very much to see a statement put into the MANUAL in connection with these definitions of different processes, stating very clearly that it either is or is not recommended practice. I do not think that it is sufficient to leave that as vague as it evidently is in the minds of many of our own members now, because those of us who have got to use this MANUAL in soliciting the sale of treated materials will certainly have that question put very definitely to us, and we must be in a position to answer it yes or no. I am not clear myself, as to how I could answer that question in regard to the Allardyce process. As I understand it, that is exactly the point made by Mr. Kuehn. It has nothing to do with the point made by Mr. Cecil. A railroad might say, "We want to use the Allardyce process." Now is this definition the recommened practice of the American Wood-Preservers' Association? I do not know. I do not care whether the statement is that these terms are placed in the MANUAL as definitions and nothing more, or whether they are put in the MANUAL as definitely recommended practice, but one or the other I think should be clearly stated.

MR. WM. A. CECIL: Mr. President, I agree with that idea. I believe that anything that goes in the MANUAL should be recommended practice without any further statement, and any process that is in use or is used is recommended practice for the purpose for which it is the best. Now then when you say in your MANUAL, make a specific statement to the effect that the Association does not recommend, or it is not the recommended practice of the Association, or anything of that kind, you may retard the development of a process that would really be valuable in the future. You would be doing the man who has given his time and his work to the development of the process, or to working out the idea an injustice, you would just injure his business. That is all there is about it.

THE PRESIDENT: Gentlemen, the instructions to the Committee on Terminology were to present for adoption at this annual meeting standard names of processes, preservatives, machinery and equipment and terms of plant operation, for insertion in the MANUAL. In adopting these standard names of processes and their definitions I do not believe we are putting the Association on record as stating just how these processes shall be carried out in adopting the definition which describes the process. This, it seems to me, would answer Mr. Moses' question.

MR. EARL STIMSON: The MANUAL is to be called the MANUAL OF RECOMMENDED PRACTICE, and as such should contain only the results

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of the work of the Association—matter which has been subject of the independent study and research of the various committees and in turn approved and adopted by the Association, in the form of definitions, methods, specifications, etc. These descriptions of processes (mostly patented), do not therefore come within the scope of the MANUAL, and should be received as information only, to appear in the PROCEEDINGS as part of the Committee report and to be published (as some have already been) in the HANDBOOK, which is a book of general information only.

MR. JOHN FOLEY: Mr. Chairman, it seems to me extremely difficult to define a wood-preserving process; you have to make a description of it. As soon as you try to describe it, you practically make specifications under which to operate it. While the Committee has told how the processes should be worked, it has not fixed any very tight standard to be adhered to by saying each process "consists essentially of the following steps." Then the Committee says that the solution is forced into the wood after about so much time, at about so much temperature, to give wide ranges of absorption.

It seems to me that the American Wood-Preservers' Association, provided all the various limitations are acceptable, could consider the description as acceptable for the process in question; that is, a standard description of the process which anybody soliciting business could use, the buyer deciding whether he desired 4 lbs. or 24 lbs. per cubic foot. I feel that you must, if you put these things into the MANUAL as recommended practice, regard them as standard within the limitations of the description.

MR. L. B. MOSES: I have evidently not succeeded in making clear what I had in mind. I am not either advocating or opposing the recommendation of any process. I fully understand that it is not the thought of this Committee to make any recommendation that the Allardyce process shall be used. What I want to know is this, are we to understand if a railroad, for example, should decide to use the Allardyce process, we are, as the result of this Committee's report, authorized by this Association to say if you use the Allardyce process this is the recommended practice as to how it shall be used? I have no reason to suppose that this is not a perfectly proper thing to say to them, on the contrary, I suppose it is. I have every confidence that it is but I want that definitely stated one way or the other, not as a recommendation of process, but as a statement of this Association's recommended practice for the handling of that process if it is used, if it goes in the MANUAL that should be stated yes or no, that if the Allardyce process is used this is or is not the Association's decision as to how it should be done. That is as I understand the question Mr. Kuehn raised. It is not a question of recommending a process.

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MR. A. L. KUEHN: Mr. Chairman, there is another important point to this thing. Some of these processes are patented. Who is the one that is to furnish the description? Were these descriptions furnished by the originators or owners of the process? In fact, that is the way Mr. Moses would get his specifications.

MR. J. CARD: These descriptions, Mr Kuehn, were submitted to all parties that were interested in these different methods of treatment.

MR. A. L. KUEHN: I think that is a point that should be made clear also.

THE PRESIDENT: Gentlemen, that being the fact it seems to me it might be in order to have a motion as to how we expect to use these terms if they are put in the MANUAL.

MR. J. H. WATERMAN: Do we not want that motion after we are through, not now? Is there not a motion before the house now?

THE PRESIDENT: No.

(Mr. Card then read the description of the Bethell process. See page 76).

THE PRESIDENT: What is your pleasure, gentlemen?

MR. J. C. WILLIAMS: I move the definitions be accepted.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: It has been moved and seconded that this definition be accepted.

MR. GEO. M. HUNT: Mr. Chairman, there is one word I would like to say now, so that we will all understand thoroughly that these processes are not necessarily as originally patented. If you will look up Bethell's patent, No. 7731, you will find that he did not use this process at all. He used creosote entirely, but he merely soaked the timber in creosote. It was some time after this patent was granted that he began to use pressure. That is covered here in the preliminary paragraph, where it says,

> In some cases the process has gradually changed in one or more details from that described in the original patent, but still retains its name.

This definition, therefore, is meant to cover the process as it is now understood, and by accepting this definition you will give a definite meaning to the Bethell process while if this Association does not adopt it, or some other association does not adopt it, there are a number of things that might be called Bethell.

MR. K. F. STAHL: Would it not be better in paragraph "B" to substitute the word "creosote" for "oil"? While we understand that we mean creosote, I think it would be better to use the word "creosote" in place of "oil."

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MR. J. C. WILLIAMS: I disagree with the gentleman's remarks. You could inject petroleum oil by that process. You certainly could inject water-gas tar, and you cannot limit the description of the Bethell method of operation by putting in one particular type of preservative. The description is better as it is.

THE PRESIDENT: Gentlemen, if you are ready for the question, all those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read the description under "Boiling." See page 77.)

MR. J. H. WATERMAN: I move you this be adopted.

THE PRESIDENT: Is there a second to the motion?

MR. A. H. NOYES: I second the motion.

MR. W. F. GOLTRA: I notice that most of the specifications are designated by the name of patentee or inventor, for instance, Bethell, Burnett, Rueping, Boulton, Lowry, etc. Then why not designate the boiling in oil process "Curtis and Isaacs" instead of "Boiling"? I would suggest that we head that paragraph "Curtis and Isaacs" instead of "Boiling."

MR. J. B. CARD: This method of treatment has been known as the Boiling process more than it has been known as a Curtis or an Isaacs process. It has been commonly called a method of boiling.

MR. J. H. WATERMAN: Better use the common name for it. People would understand it.

THE PRESIDENT: Are you ready for the question? All those in favor of the motion signify it by saying "aye"——

MR. F. D. MATTOS: I think that paragraph "E" should be changed to read "5 to 20 lbs. per cubic foot" as 10 to 12 lbs. per cubic foot does not cover all cases. For instance in the case of paving blocks we inject as high as 16 lbs. creosote oil per cubic foot, while in the case of piles 10 to 20 lbs. is used. The injection of 5 lbs. per cubic foot refers to when the Boiling process is used in connection with the Rueping process. I think that this change should be made in order to cover all cases.

MR. J. H. WATERMAN: Do you use the Rueping process with the Boiling process?

MR. F. D. MATTOS: Yes, sure. The Boiling process is merely the means of seasoning timber artificially.

MR. J. H. WATERMAN: What do you want that to read, from 5 to 12 pounds?

MR. F. D. MATTOS: No, from 5 to 20 pounds.

MR. GEO. M. HUNT: How would this be, Mr. Mattos? To fix it, as in the process before, "the amount of oil injected depends upon

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the specifications of the purchaser, but the absorption per cubic foot is usually within the following ranges," and then give the ranges as given now under paragraph "E." Would not that be correct?

MR. F. D. MATTOS: Yes, it could be that way, but I think it would be more satisfactory if it was clearly stated in this paragraph. Of course, a good many do not seem to understand that the Boiling process is merely the means of reducing the moisture content of timber under treatment. The amount of oil injected cuts no figure.

MR. J. C. WILLIAMS: Mr. President, it seems to me that if you amend paragraph "E," and give the same information that you do in the last four lines of paragraph "C" of the Bethell process, that you have fixed the quantities of preservatives and you have given the same ranges under one process that you have under the other.

MR. GEO. M. HUNT: Mr. Chairman, if you do that you are not describing the Boiling process, but you are describing a combination of the Boiling and some other process. It is thoroughly recognized that the Boiling can be used in combination with other processes merely to do your preliminary seasoning, by boiling in oil instead of steaming, or some other method, but we are describing here merely the Boiling process as it is usually carried out when you do not combine any other process with it. So I would like to ask Mr. Mattos if in the straight Boiling process this "usually 10 or 12 lbs. per cubic foot" is not correct? Not combined with any other process?

MR. F. D. MATTOS: It is correct as far as the treatment of structural timber is concerned, but in the case of piles and paving blocks a much heavier treatment is given.

MR. GEO. M. HUNT: You would like to raise that from 12 to 16 pounds?

MR. F. D. MATTOS: From 10 to 16 pounds.

MR. J. H. WATERMAN: He would like to have it read 5 to 16 pounds.

MR. GEO. M. HUNT: They do not put in 5 lbs. according to the Boiling process.

MR. F. D. MATTOS: That is in combination with Rueping and Boiling.

MR. J. B. CARD: The Committee has no objection to changing that paragraph "E" to read "10 to 16 lbs. per cubic foot" instead of from 10 to 12 lbs. per cubic foot.

THE PRESIDENT: Are you ready for the question? All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

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(Mr. Card then read the description of the Boulton process. See page 77).

THE PRESIDENT: What is your pleasure? Is there a motion to adopt this definition of this process?

MR. F. J. ANGIER: Mr. President, I move that the definition of the process be adopted.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: Any comments? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read the description of the Burnett process. See page 78).

MR. E. H. BOWSER: I move its acceptance.

MR. A. R. JOYCE: I second the motion.

THE PRESIDENT: It has been moved and seconded that we accept this definition. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of the Card process. See page 78).

MR. F. J. ANGIER: Mr. President, change the word "creosote" to "oil" in the last paragraph, making it read "2 to 3 lbs. of oil per cubic foot."

THE PRESIDENT: That is accepted by the Committee.

MR. J. H. WATERMAN: I move its adoption.

MR. EARL STIMSON: If that is the case the "creosote" in "A" should be changed.

MR. F. J. ANGIER: Yes.

MR. E. H. BOWSER: I second the motion.

THE PRESIDENT: All those in favor of accepting this definition please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. W. H. GRADY: Mr. President, it seems to me if you are going to make this process read "oil" in place of "creosote," that ought to apply to all the others.

MR. J. B. CARD: The Committee thinks it should apply.

MR. J. H. WATERMAN: We have changed it in two places, so we might as well change it in all.

MR. J. B. CARD: We have changed it in three paragraphs. "A," "B," and the last paragraph.

MR. J. C. WILLIAMS: Mr. President, that brings up the question whether the Card patent covers all oils, or is limited specifically to zinc chloride and creosote only.

MR. L. B. MOSES: That process covers everything in the world (laughter).

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(Mr. Card then read a description of the Lowry process. See page 79).

MR. E. H. BOWSER: I move the acceptance of it.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: It has been moved and seconded that we accept this definition. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of the Rueping process. See page 79).

MR. J. B. CARD: There is a correction here in paragraph "D." Where it says "the air imprisons during 'a,' expands during 'b,'" that should be 'expands during 'd.'"

THE PRESIDENT: What action do you wish to take on this?

MR. J. C. WILLIAMS: I move it be accepted.

MR. A. R. JOYCE: I second the motion.

THE PRESIDENT: All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of Steaming process. See page 80).

MR. F. J. ANGIER: Mr. President, I move the adoption of this definition.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: It has been moved and seconded that we adopt this paragraph. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of the Wellhouse process. See page 80).

MR. J. B. CARD: The Committee will scratch out the last clause, "the process is not now in extensive use."

MR. H. A. PAUL: I would like to ask the Chairman of this Committee if the Wellhouse process was ever used without a preliminary steaming of ties?

MR. J. B. CARD: Yes, the Wellhouse process was used on seasoned timber without any steaming.

MR. H. A. PAUL: I would like to ask the Chairman what the result was when it was used without preliminary steaming, in absorption as to amount?

MR. J. B. CARD: The seasoned ties would absorb without steaming much better than green ties would that were steamed.

MR. H. A. PAUL: That is not my point. When the dry ties were steamed, given a preliminary steaming, how did the absorption compare with dry ties treated without preliminary steaming?

MR. J. B. CARD: I do not think I could answer that question, because I think everyone discontinued the steaming of seasoned wood

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in the Wellhouse process. In other words, the treatment was so much better without steaming that it was discontinued. You would only add moisture to the wood by steaming it, and therefore there was nothing gained by putting a long steam on dry wood. You would not help the penetration in any way unless possibly with certain kinds of wood that might have casehardened a little in seasoning, in those woods it might have improved their absorption qualities, but the average wood like red oak would take a better absorption without steaming than it would with steaming.

MR. H. A. PAUL: I would like to state that in 1903 the question of dropping the preliminary steaming in the Burnett process, as a means of perhaps turning out more runs from a cylinder during the daily period came up. In an investigation of possibly one hundred runs, the preliminary steaming effected on dry loblolly-pine ties as follows: when the dry ties were not given a preliminary steaming of one hour, they absorbed by actual scale weight 60 lbs. of solution. When they were given a preliminary steaming they absorbed 100 lbs. of solution.

MR. J. B. CARD: That might be true of pine, because pine will have more of a tendency to caseharden in seasoning than hardwoods will. That would probably apply to hemlock also, and may possibly apply to tamarack, but the gain in steaming dry wood is so slight that I question if it would pay you to do it with the majority of woods.

MR. H. A. PAUL: The same was true of western yellow pine and shortleaf pine also. It is true today, I believe, and similar experiments will prove 60 and 100 lbs. approximately correct.

MR. J. B. CARD: In treating hardwoods you will get a much better penetration with seasoned oaks and no preliminary steam than you would by applying steam to them.

MR. F. J. ANGIER: Mr. President, I move the adoption of this paragraph.

MR. G. S. HARDEN: I second the motion.

MR. J. C. WILLIAMS: Mr. President, the last paragraph says:

> The object of the glue, followed by the tannin, is to form a leathery precipitate to plug the pores in the wood and retard the leaching of the zinc chloride.

Under the heading of the Lowry process on the preceding page, the description read that

> The air imprisoned by injecting the oil without a preliminary vacuum expands during the final vacuum forcing out a certain amount of oil with it.

Both of those details are, as I understand it, essential features of those patents. Now if it is stated as a fact that the Lowry process

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does a certain thing, why can it not also be stated as a fact that the Wellhouse process does another certain thing, and the word "object" be left out. This would make the description state the fact that the glue and tannin actually form a leathery precipitate to plug the pores in the wood and retard the leaching of the zinc chloride.

MR. J. B. CARD: There has been an argument over this Wellhouse treatment for a great many years, as to just exactly what the glue and tannin accomplish in the treatment of wood, and the Committee has defined this in stating that the object of this glue and tannin is to form a leathery precipitate. Whether it does or not, I do not know that the Committee cares to state. The patent says that the object of using the glue and the tannin is to do certain things, and I do not think it is for the Committee to say that they do.

MR. J. C. WILLIAMS: Is the Committee satisfied that the Lowry patent does what the Committee states that it does?

MR. J. B. CARD: Yes, the Committee is satisfied with the definition of the Lowry process.

THE PRESIDENT: All in favor of the question signify it by saying "aye"; contrary, "no." The motion is carried. We will have the next process.

(Mr. Card then read the description under Non-Pressure processes. See page 80):

MR. C. H. EASTWICK: Referring to the first paragraph, it is not descriptive of the process. Would the Committee object to omitting that paragraph, on the same ground as applied to the Allardyce process?

MR. A. R. JOYCE: Mr. President, in the description under "Methods" there have been sentences included telling about what the particular method was used for. The first part of this paragraph is all right. It tells what a portion of the treament is used for. The last part might be subject to criticism because it says:

> Where it is impracticable or unnecessary to use a more effective treatment.

The first part certainly could be included.

THE PRESIDENT: Does that satisfy you?

MR. C. H. EASTWICK: That same thing may apply to various processes described here. As I understand it, this is an attempt to describe the process and not describe the relative value, and this paragraph would indicate that it was impractical for many purposes, and, without investigation or report going with this to show the value of the various processes, I think the first paragraph should be omitted. The second paragraph describes clearly what the process is, which I understand is the intention of this article.

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MR. A. R. JOYCE: Mr. President, I move you that this description be adopted, with the elimination in the first paragraph of everything following "Timber." Make the first paragraph read:

Used frequently on poles and structural timber,

and cut out the balance of the first paragraph.

THE PRESIDENT: Is there a second?

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. All those in favor say "aye"——

MR. GEO. M. HUNT: May I suggest an amendment here, which I think will please both gentlemen?

THE PRESIDENT: An amendment to the motion?

MR. GEO. M. HUNT: Yes.

THE PRESIDENT: What is it?

MR. J. B. CARD: The Committee will change this first sentence to read:

Used frequently on poles and construction timber where it is not desirable to use a more effective treatment.

MR. J. C. WILLIAMS: Mr. President, could we not omit the word "frequently" without doing any damage? I think that the fewer adjectives and adverbs we have the better.

MR. WM. A. CECIL: Mr. President, it would be better to cut out the whole paragraph. I know nothing about the brush treatment, but I do not approve of putting anything in that has a tendency to limit the use of any process. In a word, I believe in giving every fellow a chance to build up and expand his business. Now then you say poles and something else there. For the man that did not understand the matter it would look as though it was not good for any other purpose, whereas they might get good service from the brush treatment for something else. I do not believe that the description will be injured by cutting out the paragraph, and I believe that a great many people may be benefited. Therefore, I would say cut it out.

THE PRESIDENT: Is there any discussion on the motion that is before the house?

MR. E. H. BOWSER: Does the motion include that revision of the paragraph?

THE PRESIDENT: The motion is that we accept this report by having the first paragraph read:

Used frequently on poles and construction timber,

and cut out the rest of the first paragraph.

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MR. A. R. JOYCE: Mr. President, I would like to add "posts" to that first paragraph, "posts, poles and construction timber."

MR. WM. A. CECIL: Why not add railroad ties? You may want to use it on them.

MR. C. H. EASTWICK: Mr. President, I could add a great many uses for brush treatment extending over about 50 years, that seem to me unnecessary to mention in this description of the application of it. If the Committee wants a list of where the brush treatment has been used we would be very glad to furnish it, and if this article is to be accurate why only mention poles and construction timber alone, because there are many other uses that it has been put to with satisfactory results.

MR. GEO. M. HUNT: Mr. Chairman, I move as an amendment to Mr. Joyce's motion that the whole first part of the paragraph be changed to read as follows:

> Used frequently on poles, posts and other timbers, in cases where it is not desired to use a more effective treatment.

MR. M. K. TRUMBULL: I second the motion.

THE PRESIDENT: Any comments on the amendment? All those in favor of the amendment signify it by saying "aye." The amendment is adopted. All those in favor of the original motion signify it by saying "aye." I do not know whether this is understood or not. There was an original motion made to accept the definition of this process by changing the first paragraph to read:

> Used frequently on poles and construction timber.

That was amended to make the first paragraph read:

> Used frequently on posts, poles and other timbers in cases where it is not desired to use a more effective treatment.

Now we voted on the amendment, and it was adopted. We are ready to vote on the original question. All those in favor of the original motion accepting the amendment changing the first paragraph, will please signify it by saying "aye." All those opposed signify it by saying "no." The motion is carried.

(Mr. Card then read the description of the Open-Tank treatment. See page 80).

MR. J. B. CARD: The Committee has changed the word "creosote" in paragraph "A" to "oil."

MR. C. H. EASTWICK: On the same ground, not being descriptive, I will ask if it will be consistent for the Committee to omit the last paragraph.

MR. E. T. CHAPIN: A very large share of the poles used in the United States are cedar poles, and this open-tank method of treating

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is the only process, practically speaking, that is used for treating cedar poles. I do not see any reason for stating that there are more practical methods of treating poles. About 75% of the poles in the United States today are cedar, and the method employed for treating cedar poles is open-tank method. In fact, seven modern plants have been installed within the last 18 months. I would suggest that the words be left out, "when it is impracticable or unnecessary to use a more effective treatment" as the open-tank method is efficient.

I would also like to make another suggestion, and that is that the official specifications covering the treatment of poles provide what is called an "A" treatment or the Dipping process, and a "B" treatment, or the Hot and Cold, and I would suggest that the capital letter "A" be used in place of the figure "1," and the capital letter "B" in place of the figure "2," as these are very generally known terms among pole men, and as long as this process is not in general use except for the butt treatment of poles, I would think that this would be a fair thing to do.

THE PRESIDENT: That correction has been made by the Committee.

MR. J. B. CARD: The Committee will change the last paragraph to read as follows:

> These methods are frequently used for posts, poles and other timbers in cases where it is not desirable to use a more effective treatment.

MR. J. C. WILLIAMS: In the introductory sentence, could we not say that the treatment can be "performed" or "done," instead of "made"? You are not manufacturing anything, you are only putting through a process, you are doing something.

MR. J. B. CARD: We can use there "can be accomplished." Does that answer your question?

MR. J. C. WILLIAMS: I think that will cover it.

MR. E. H. BOWSER: I move we accept this paragraph with the description suggested by Mr. Card in the last paragraph.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: It has been moved and seconded that this paragraph as amended be accepted.

MR. E. W. BRIGHT: In the way of information I would like to ask this Committee how it determines the period of time from 5 to 15 minutes. In No. 1 where it says,

> Dipping: Consists of submerging the wood in hot preservative for 5 to 15 minutes.

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I think we should eliminate the time there, and not mention time whatsoever, as this should be determined by the material being dipped. I suggest that we leave out the 5 to 15 minutes.

MR. J. B. CARD: We are describing here what is common practice, and that seems to be the practice in the Open-Tank treatment of submerging the wood in hot preservative for 5 to 15 minutes, and not for any longer period of time.

MR. GEO. M. HUNT: Mr. Chairman, in addition to that I would like to say, and I think Mr. Chapin will agree with me, that the Association of Cedar Pole Manufacturers have adopted a specification for Open-Tank treatment, which reads practically as ours does here, and I believe that in it they consider the dipping treatment to be from 5 to 15 minutes.

MR. E. T. CHAPIN: Yes.

MR. GEO. M. HUNT: So in this we are agreeing with what has already been accepted by the Association most concerned.

THE PRESIDENT: Are you ready for the question? All those in favor please signify it by saying "aye"; those opposed, "no." The motion is carried.

(Mr. Card then read the description of the Kyan process. See page 81).

THE PRESIDENT: What shall be done with this paragraph?

MR. F. J. ANGIER: Mr. President, I move the adoption of this paragraph.

MR. G. S. HARDEN: I second the motion.

THE PRESIDENT: Any comments? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. W. H. GRADY: I move that we accept the definitions covering processes for inclusion in the MANUAL.

MR. A. L. KUEHN: I second the motion.

THE PRESIDENT: We will vote on this motion, to adopt for insertion in the MANUAL the names of processes and their definitions, as presented by the Committee. All those in favor will please signify by saying "aye"; contrary, "no." The motion is carried.

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## REPORT OF COMMITTEE ON TERMINOLOGY.

*To the Members of the American Wood-Preservers' Association:*

Your Committee on Terminology was instructed to present for adoption at the annual meeting, for insertion in the MANUAL, terms of plant equipment and operation, also description of processes used in the United States. We submit herewith our report:

### PRINCIPAL PROCESSES USED IN UNITED STATES.

In attempting to describe the various wood-preserving processes it is recognized that the details of the procedure followed may vary at different plants using the same process. In some cases the process has gradually changed in one or more details from that described in the original patent, but still retains its name. In the following descriptions the attempt has been made to give in as few words as possible the essential details of the various processes as used at present, without attempting a rigid definition. If any errors are discovered the Committee will appreciate having same called to its attention.

**Pressure Processes.**

*Allardyce:*

Not patented. Used chiefly for ties.

Consists essentially of the following steps:

*a.* A solution of zinc chloride is forced into the wood at a maximum pressure of 75 to 100 lbs. per square inch until the desired absorption is obtained (commonly ¼ to ½ lb. dry salt per cubic foot).

*b.* The zinc chloride is then drained from the retort, and creosote admitted and injected into the wood at a pressure of about 100 to 150 lbs. per square inch until the desired absorption (usually 3 to 4 lbs. per cubic foot) is obtained.

The pressures used under *a* and *b* depend upon the character and condition of the wood under treatment. The pressure under *b* however must be higher than that under *a*.

*Bethell (Full-Cell Process):*

Patented by John Bethell in England in 1838. (See British patent No. 7731, July, 1838.) Commonly used for the creosoting of piles, poles, cross-arms, paving blocks, structural timber, lumber, and ties.

As now practiced consists essentially of the following steps:

*a.* Preliminary vacuum one-half to one or more hours.

*b.* Oil injected under pressure, maximum usually between 100 and 180 lbs. per square inch, but sometimes as low as 25 lbs.

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*c.* Final vacuum (sometimes omitted).

Green timber is usually subjected to a live steam bath at about 20 lbs. pressure for several hours before the preliminary vacuum. Seasoned timber is not usually steamed, except in the case of paving blocks. The amount of oil injected depends upon the specifications of the purchaser, but the absorption per cubic foot is usually within the following ranges:

Lumber, poles, structural timbers, cross-arms, ties, fresh water and land piles, 6 to 12 pounds.

Paving blocks, 12 to 20 pounds.

Salt water piles, 16 to 24 pounds.

*Boiling:*

Patented by Wm. G. Curtis and John D. Isaacs in 1895, and reissued the same year. (U. S. patent 545,222, and reissue No. 11,515).

Used chiefly for creosoting Douglas fir piles, timber, lumber, ties and paving blocks.

Consists essentially of the following steps:

*a.* Wood (either green or seasoned) in the treating cylinder is covered with oil at about 160° to 190° F.

*b.* Oil heated above 212° F. at atmospheric pressure and vapors passed through a condenser. (The practice with regard to temperature limits varies with different plants. In some cases a range of 215° to 225° F. is used, in others 225° to 250° F.)

*c.* Heating continued until rate of condensation falls to one-sixth to one-tenth of a pound of water per cubic foot of wood per hour. This sometimes requires 40 to 60 hours or more for green timber, but may be as low as 10 hours for dry timber.

*d.* Treating cylinder partially emptied and refilled with cooler oil to lower oil temperature before starting pressure.

*e.* Pressure applied, maximum 120 to 180 lbs. per square inch, until desired absorption obtained; usually 10 to 16 lbs. per cubic foot.

*Boulton (Boiling Under Vacuum):*

Patented by S. B. Boulton in England and the United States. (See U. S. patent 247,602, issued September 27, 1881.) The first mention of boiling under vacuum, however, appears in Bethell's British patent No. 7731, July, 1838. Patent modification applied for in 1915 by O. P. M. Goss.

Used chiefly for the treatment of Douglas fir piles, timber, ties, lumber and paving blocks.

As now practiced it consists essentially of the following steps:

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*a.* Timber immersed in hot creosote and subjected to a vacuum, and the escaping vapors drawn through a condenser.

*b.* Temperature (usually 190° to 215° F.) and vacuum maintained until the rate of condensation of water falls to a specified amount per cubic foot of wood per hour—usually one-sixth to one-tenth of a pound.

*c.* Vacuum discontinued and pressure applied until desired absorption obtained. This is commonly 12 to 16 lbs. per cubic foot for paving blocks, 12 to 14 lbs. for piles, 8 to 12 lbs. for lumber and timber, and 5 to 8 lbs. for ties.

The object of the vacuum is to evaporate the water from the wood at a lower temperature than in the ordinary steaming or straight boiling processes.

The Goss modification provides for a heating period of several hours at atmospheric pressure in oil at a temperature of 190° to 215° F. before the vacuum is applied, and a heating bath in oil at atmospheric pressure after the oil pressure period.

*Burnett:*

Patented in 1838 in England by William Burnett. (See British patent No. 7747, July, 1838).

In general use for treating ties, lumber, and timber with zinc chloride.

As now practiced consists essentially as follows for seasoned wood:

*a.* Preliminary vacuum.

*b.* Zinc chloride solution applied under pressure of 100 to 175 lbs. per square inch, to approximate refusal.

For green timber, a steaming period of 1 to 5 or more hours at about 20 lbs. is usually applied before the vacuum. The strength of the zinc chloride solution is generally so regulated that at refusal the timber will have absorbed from ¼ to ½ lb., usually the latter, of dry zinc chloride per cubic foot.

The original Burnett patent covers only the use of zinc chloride by soaking the wood in 2.4% solution of it for 10 to 21 days. The use of pressure with zinc chloride is a later development.

*Card:*

Patented by J. B. Card in 1906. (U. S. patent No. 815,404).

Used chiefly for ties, lumber and timber.

The essential parts of the process are:

*a.* The use of a mixture containing about 80% of zinc chloride solution and 20% of oil.

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*b.* The method of keeping the zinc chloride and oil mixed during treatment by means of a rotary pump, which draws the mixture from the top of the treating cylinder and returns it at the bottom through a perforated pipe.

The use of steaming, vacuum, and pressure are the same as in the Bethell process.

It is customary to inject about ½ lb. of dry zinc chloride and 2 to 3 lbs. of oil per cubic foot.

*Lowry (Empty-Cell Process):*

Patented by C. B. Lowry in 1906, (U. S. patent No. 831,450.)

Used chiefly for creosoting air-seasoned cross-ties but also for poles, posts, paving blocks and silo staves.

Consists essentially of the following steps:

*a.* Without first drawing a vacuum, creosote at not to exceed 200° F. is injected into the wood to refusal, or to a specified amount.

*b.* A quick vacuum is drawn to remove the excess oil from the timber.

The air imprisoned by injecting the oil without a preliminary vacuum expands during the final vacuum, forcing out a certain amount of oil with it. For this reason the process is classed as "empty-cell."

It is customary to leave in ties a net of about 2½ gals. of creosote per tie, (6 to 8 lbs. per cubic foot), and 6 to 10 lbs. per cubic foot in other timber.

*Rueping (Empty-Cell Process):*

Patented in the United States in 1902 and 1911 by Max Rueping. (U. S. patents 709,799 and 1,008,864. The first patent was reissued No. 12,707, Oct., 1907).

Used chiefly for ties and lumber.

As commonly used, the process consists of the following:

*a.* Treating cylinder, containing the wood, is filled with compressed air and so held for an hour or more.

*b.* Treating cylinder filled with oil allowing air to escape, but without reducing pressure.

*c.* When treating cylinder is full of oil, pressure is increased to a maximum of 150 to 200 lbs. per square inch, and held to refusal, or until specified absorption obtained.

*d.* Oil drained and vacuum drawn to remove excess of oil from the wood.

The air imprisoned during *a* expands during *d* forcing out a certain amount of oil with it, and the process is, therefore, called an "empty-cell" process. If desired, *a* may be omitted, and the air pressure applied after *c*.

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If green timber is treated, it is first artificially seasoned by steaming, boiling, or boiling under vacuum, before the pressure is applied.

Net absorption, usually 4 to 6 lbs. per cubic foot.

*Steaming (Colman Process):*

Not patented.

Used almost exclusively for the treatment of Douglas fir piles.

Consists essentially of the following steps:

*a.* Timber steamed at a pressure of 50 to 100 lbs. per square inch for 3 to 8 hours; time and pressure varying according to dimension and previous degree of seasoning.

*b.* Steam released and vacuum drawn until timber is considered seasoned. This usually requires from 7 to 14 hours. The temperature within the treating cylinder during the vacuum period is usually maintained between 180° and 212° F.

*c.* Oil injected at a pressure of 80 to 140 lbs. per square inch until desired absorption is obtained.

*Wellhouse:*

Patented in 1879 by Wm. Wellhouse and Erwin Hagen. (See U. S. patent 216,589.)

Used chiefly for ties.

Consists essentially of the following steps:

*a.* A solution consisting of 1½% to 3% of zinc chloride and ½% of glue is injected into the wood at a pressure of about 125 lbs. per square inch for 3 to 6 hours.

*b.* The pressure is released, cylinder drained and a ½% solution of tannin is injected at a pressure of about 125 lbs. per square inch for about 2 hours.

The object of the glue, followed by the tannin, is to form a leathery precipitate to plug the pores in the wood and retard the leaching of the zinc chloride.

**Non-Pressure Processes.**

*Brush Treatment:*

Used frequently on poles and construction timber.

Consists in applying the hot preservative to the dry timber by means of a brush. Two coats, 24 hours apart, are customarily used.

**Open-Tank Treatment.**

Can be accomplished in two general ways:

A. *Dipping:*

Consists in submerging the wood in hot preservative for 5 to 15 minutes.

B. *Hot and Cold Bath:*

More effective than A.

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Consists essentially of the following steps:

*a*. The wood is heated in oil at 200° to 225° F., for one or more hours.

*b*. It is then either quickly transferred to a tank of cool creosote and allowed to stand several hours, or the heating is discontinued after *a*, and the wood and oil allowed to cool together.

These methods are frequently used for posts, poles, and other timbers in cases where it is not desirable to use a more effective treatment.

*Kyan (Kyanizing):*

Patented in England by John H. Kyan in 1832. (British patents No. 6,253, Sept., 1832, and No. 7,001, March, 1836.)

Used for ties and construction timber.

Consists in soaking seasoned wood in a solution of mercuric chloride (usually 1%) in an open vat of wood or concrete. It is customary to allow the wood to soak one day more than one day for each inch in thickness.

The original Kyan patent specified a solution of 1 lb. of corrosive sublimate to 5 gals. of water (about 2.4%), and the wood was soaked from 14 to 21 days.

Other preservatives, such as zinc chloride or sodium fluoride in water solutions, may be used in the same manner, except that the solutions should be stronger.

The term Kyan process or Kyanizing, however, is limited to the use of mercuric chloride. When other preservatives are used the process is called "steeping" or "soaking."

J. B. CARD, *Chairman*
E. T. HOWSON
GEO. M. HUNT
G. B. SHIPLEY
M. K. TRUMBULL

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THE PRESIDENT: I wish to announce that tomorrow we will have a paper illustrated by slides on "The Bad and the Good in the Handling of Wood," by Mr. Waterman. This will be followed by a talk illustrated with slides on the same subject by Mr. Rex. I am sure that the members will find these two talks very interesting.

I now have the pleasure of introducing to you one of the oldest men in the wood-preserving industry, and a pioneer in the industry in the West, I want you to see and meet Mr. J. D. Isaacs (applause).

MR. J. D. ISAACS: Gentlemen, I am very glad to have the pleasure of an introduction to you, but I am very sorry that circum-

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stances have been such that I could not attend any of your meetings heretofore. I have watched the progress of this Association with great interest. You are doing a fine work. You have raised this from a mere cut-and-dry matter to a profession and an art and a science, and I hope you will keep on with the good work. I thank you, indeed, for this introduction (applause).

THE PRESIDENT: If there is no further business to be brought before the Association, we will adjourn until 10 o'clock tomorrow morning. We have a very full day tomorrow and I hope that we can get to work early.

An adjournment was then taken.

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## WEDNESDAY MORNING SESSION.

**January 24.**

The meeting was called to order at 10 o'clock A. M. by President Crawford.

THE PRESIDENT: Our Secretary has a communication he would like to read.

SECRETARY ANGIER: This is a telegram from R. L. Allardyce, Texarkana, to C. M. Taylor:

> Regret cannot attend meeting on account of contracting severe cold. Hope you will have a good meeting. Remember me to all.
> ALLARDYCE.

THE PRESIDENT: I would like to ask if the Entertainment Committee has any announcement this morning. Are any members of the Entertainment Committee here? If not, we will have the report on Service Tests of Ties and Structural Timber, which was left over from yesterday. I would like to say before the Committee makes the report that there are a great many tables and data accompanying this report, which have not been printed, due to the lack of time after the report was turned over to the Executive Committee, but will be printed in the PROCEEDINGS. The Secretary will call the names of the Committee.

SECRETARY ANGIER: Mr. C. P. Winslow, Chairman, Mr. E. H. Bowser, Mr. C. F. Ford, Mr. C. E. Gosline, Mr. F. D. Mattos, Mr. H. M. Rollins, Dr. Hermann von Schrenk and Mr. T. G. Stull.

THE PRESIDENT: Mr. Winslow cannot be here, and Mr. Gosline has been asked to take charge of the Committee in presenting the report. The gentlemen whose names have been called, please come forward and take chairs on the rostrum.

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MR. C. E. GOSLINE: Mr. President and Members: The report as outlined in this pamphlet has been made up almost entirely by Mr. Winslow and his office force, and there is nothing new or startling in it. It is simply following up and compiling the tables and tabulating the records of different railroads on tests. There are some thirty or forty tables to go along with this report. These tables lack information on records of water-gas-tar mixtures and crude oil. It is the desire of the Committee that a recommendation be made that we try to get these records which are lacking.

There are also a number of railroads that have not made any report of any service tests on ties, which they have in tracks, and which would be of very great value to the Association, and would make the tabulations and records very much more complete. I do not know that there is anything more to add to the report, as we went over the same thing last year. I do not believe there is any necessity for taking up any more time.

## REPORT OF COMMITTEE ON SERVICE TESTS OF TIES AND STRUCTURAL TIMBER.

*To the Members of the American Wood-Preservers' Association:*

The instructions issued to your Committee by the Executive Committee of the Association were substantially as follows:

1. Continue the compilation and tabulation of all data which can be secured on service tests of ties in both steam and electric roads, indicating in each record the kind of wood, the method of treatment, and all other data which will be of value. Similar data should be secured so far as is possible for ties, poles, piles, posts, bridge timber and in fact, for all timber except paving blocks.

2. Point out on what species of wood and character of treatment service records are lacking.

3. Make further recommendations as to how additional data may be effectively procured.

4. Present recommendations for future work to be undertaken by your Committee.

The following briefly outlines the progress which has been made by your Committee in accordance with the foregoing instructions:

**1. Continuation of the Compilation and Tabulation of Data, etc.**

First attention has been given to ties in steam roads. A systematic collection, compilation and tabulation of data of this character has been undertaken by the Forest Products Laboratory in co-operation with your Committee and also in co-operation with the Committee on Wood Preservation of the American Railway Engineering Association.

The general plan is for the various railroads to annually submit a report showing their results with various test tracks, and experimental ties, which are then classified, co-ordinated and tabulated systematically.

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The results of this work for the current year are embodied in a report, with the accompanying tables, entitled "Service Tests of Cross-Ties" by P. R. Hicks, under whose supervision the work was conducted, and who has kindly furnished his complete report for the use of the Committee.

With a view to securing similar data for ties used in electric railways as is now currently being secured for ties in steam roads, the matter was taken up with officers of the American Electric Railway Engineering Association. Forms of the submission and recording of data have been prepared and submitted to this Association, and while time has not yet permitted a systematic collection and tabulation of data of this character, it is confidently expected that during the ensuing year it will be possible to secure exhaustive records from this source.

Service-test records on posts and poles are presented by Mr. Hicks, who has kindly furnished this report for the use of the Committee. Data on other forms of timber have also been collected to a certain extent but time has not permitted the systematic tabulation and presentation of the result.

**2. Species of Wood and Character of Treatment on Which Service Records are Lacking.**

A perspective view of the character of the records for ties in steam roads can best be obtained by reference to Table 2 in the accompanying report by Mr. Hicks.

A study of his data further shows that no authentic records are at present available for Port Orford cedar or redwood ties, while only a few records are available on western hemlock, white fir, western red cedar, and some of the oaks and pines. Special emphasis should, therefore, be laid in the future to procuring data on these species, both treated and untreated.

**3. Recommendations as to How Additional Data May be Effectively Procured.**

Additional data cannot only be effectively procured, but the work of collection, tabulation and analysis of data can be greatly assisted by observance of the following:

(*a*) Prompt compliance by various companies having test tracks, or other experimental timber installed, with requests for annual reports on the character and condition of the experimental timber. While the co-operation and assistance of the many companies furnishing the information upon which the tabulations accompanying this report are based is sincerely appreciated, the furnishing of this data prior to October 1 of each year would greatly facilitate the Committee in the

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arrangement and proper analysis of the material in time for presentation at the annual meeting of the Association.

(*b*) So far as practicable the data should be furnished on standard forms which should be approved and provided by the Committee for that purpose, and an earnest attempt should be made to provide all of the information called for in such forms. This procedure would greatly facilitate in the annual tabulation and analysis of the data.

(*c*) The co-operative work with the American Electric Railway Association should be supported and developed. It is believed that a considerable amount of valuable data may be procured through the various companies of this Association. A compilation and analysis of data on ties used in electric railways both in interurban tracks and in tracks in paved and unpaved streets is a phase of the subject which has not yet received the careful attention it deserves.

(*d*) As the work develops similar co-operative arrangements should be effected with other associations or organizations which can assist in procuring records of other forms of timber, such as poles, posts, mine timber, etc.

**4. Recommendations for Future Work.**

It is the feeling of your Committee that the annual compilation of durability records on the systematic basis which has now been established should be continued and a strong effort should be made not only to continue this work for steam roads but to develop it to cover, first, ties in electric roads and subsequently, as rapidly as possible, other forms of timber.

C. P. WINSLOW, *Chairman.*
E. H. BOWSER,
C. F. FORD,
C. E. GOSLINE,
F. D. MATTOS,
G. L. POLLOCK,
H. M. ROLLINS,
H. VON SCHRENK,
T. G. STULL.

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## SERVICE TESTS OF CROSS-TIES.

By P. R. Hicks.

*(January, 1917.)*

*Engineer in Forest Products,*
*Forest Products Laboratory, Madison, Wis.*

The records embodied in the accompanying tables were compiled as a continuation of the report written by C. P. Winslow and C. H.

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Teesdale, published in the 1916 PROCEEDINGS, and will be compiled annually hereafter. They comprise 872 records on 61 species, of which 53 were completed. The report published in 1916 includes all records upon which information was available at the time the report was prepared. In the present report those records upon which no additional information could be obtained were eliminated. Several new service-test records not previously reported were submitted during 1916 and are included in the present report.

Acknowledgement is made to the railroad officials who furnished the information, data, and records upon which this report is based.

In compiling these data, letters were sent to all railroad companies known to have service-test records and to many others. These letters were written about September 1, 1916, requesting the information by October 1, 1916, although most of the data were received during the latter part of November and December. While it is realized that inspections in many cases are made late in the year, and that it requires considerable time to write up these inspections, it is desired to emphasize the fact that if the records are received early they can be summarized in time for publication prior to the annual meeting of the Association.

Furthermore, the records could be improved by including such items as dimensions of the ties, tie-plated or not, size of tie-plates, kind of spikes, traffic in tons per annum, weight of rail, ballast, placed on curve or tangent, percentage of grade, spacing in the track, cause of removal, etc., all of which have a more or less direct bearing upon the durability.

The greater part of the accompanying records are from reports of actual test tracks. This should make the records most valuable, as many of the railroads have learned that records can be kept more accurately in this manner than by trying to keep a record of all the ties in one division or system, as was brought out by F. J. Angier at the 1911 meeting of the American Wood-Preservers' Association.

Table 1 gives a list of the number of records and species submitted by the various railroads, and is self-explanatory. Other railroads undoubtedly have experimental tracks or accurate durability records, and it is the writer's desire to be informed of these companies not now included so that a complete list may be had.

Table 2 gives the number of completed and unfinished records for the various treatments, and Table 3 an itemized statement of those which have been completed.

Forty completed records are given for 18 untreated species on six railroads, seven for four Burnettized species on three lines, and six for five species treated by three other methods. Of the latter, beech, red

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oak, and loblolly pine treated by Long's liquid and placed on the Illinois Central in Mississippi had an average life of 4¼, 4¾, and 5½ years, respectively, which indicates this preservative was not a success. The same is true of the red oak ties treated with creosol-calcium, the average life being but four years.

The Douglas fir was divided where possible into the true Coast fir and that grown in the Rocky Mountains. The average life of 100 unseasoned Coast fir ties laid with cut spikes without tie-plates was 7.5 years, although the 557 green ties in the track laid with various fastenings gave an average life of 8.3, as compared with 8.4 years for 1078 seasoned ties in the same location. The average life of 570 green Mountain fir ties in another location was 7.6 years compared with 7.7 years for 571 seasoned ties. A direct comparison of the Coast and Mountain variety cannot be made, however, on account of climatic conditions. The Coast fir was laid in a much more favorable location compared with that of the Mountain variety.

The average life of 1095 southern yellow pine ties treated with zinc-creosote (process not stated) was 15.6 years, while 16 tupelo gum ties treated in the same way lasted but 8.5 years on the G. H. and S. A. Railway. Forty-five Burnettized red gum ties placed by this company averaged 6 to 7 years. Two groups of 67 and 68 longleaf pine Burnettized ties averaged 14.8 and 14.4 years, Coast Douglas fir 10 to 11 years, and southern sap pine 5.4 and 5.7 years, all of which were treated with zinc chloride in the tracks of the N. Y., N. H., & H., Southern Pacific, and the G., H., & S. A. Railways, respectively.

Attention is called to the untreated completed records submitted by the C., B., & Q. Railroad, where the average life of several species was less in the Lines East than in the Western Lines.

It is noted that no authentic records were obtainable for Port Orford cedar and redwood ties, and only a few records are available on western hemlock, white fir, western red cedar, and some of the oaks and pines. Hence it is particularly desirable to obtain records on both treated and untreated ties of these species.

The following statement submitted by J. H. Waterman of the C., B., & Q. Railroad, is of general interest, as it summarizes the various treatments by species, and is an average of the conditions on 20 divisions of this railway in the states of Wisconsin, Illinois, Missouri, Iowa, Nebraska, Colorado, South Dakota, and Wyoming.

These ties were set in 1909, also 1910, which fact should be kept in mind in analyzing the tables. A general summary, regardless of species, follows:

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## Ties Placed in Experimental Tracks, C. B. & Q. Railroad, 1909-1910(a).

| Process. | Total Placed. | Total Removed to Jan. 1917. | Per Cent. Removed Acct. Decay | Per Cent. Removed to Jan. 1917. Other Causes. |
|---|---|---|---|---|
| **ASH.** | | | | |
| Straight Creosote .... | 35 | ... | .... | .. |
| Card ..... | 388 | 12 | 0.5 | 2.5 |
| Burnett ..... | 31 | ... | .... | .. |
| Untreated..... .. | 116 | 103 | 87.0 | 1.7 |
| **BIRCH.** | | | | |
| Straight Creosote .... | 133 | ... | .... | .. |
| Card ..... | 1075 | 20 | 0.3 | 1.7 |
| Burnett ..... | 103 | 3 | 1.9 | 1.1 |
| Untreated ..... | 217 | 217 | 98.0 | .. |
| **CYPRESS.** | | | | |
| Straight Creosote .... | 54 | ... | .... | .. |
| Card ..... | 662 | 6 | 0.2 | 0.8 |
| Burnett ..... | 55 | ... | .... | .. |
| Untreated ..... | 225 | 115 | 51.0 | .. |
| **COTTONWOOD.** | | | | |
| Straight Creosote .... | 133 | ... | .... | .. |
| Card ..... | 456 | 8 | .... | 2.0 |
| Burnett ..... | .. | ... | .... | .. |
| Untreated ..... | 86 | 86 | 96.0 | 4.0 |
| **ELM.** | | | | |
| Straight Creosote .... | 328 | 7 | 0.7 | 1.3 |
| Card ..... | 957 | 12 | 0.5 | 0.5 |
| Burnett ..... | 297 | 6 | 0.7 | 1.3 |
| Untreated ..... | 190 | 163 | 82.0 | 4.0 |
| **SOFT MAPLE.** | | | | |
| Straight Creosote .... | 201 | 4 | 0.5 | 1.5 |
| Card ..... | 731 | 28 | 0.5 | 3.5 |
| Burnett ..... | 182 | 9 | 1.0 | 4.0 |
| Untreated ..... | 126 | 122 | 98.0 | .. |
| **RED GUM.** | | | | |
| Straight Creosote .... | 137 | 2 | .... | 1.0 |
| Card ..... | 661 | 17 | 1.0 | 2.0 |
| Burnett ..... | 119 | 24 | 15.0 | 5.0 |
| Untreated ..... | 151 | 147 | 96.0 | 1.0 |
| **HEMLOCK.** | | | | |
| Straight Creosote .... | 235 | 1 | .... | 4.0 |
| Card ..... | 1298 | 26 | 0.1 | 1.9 |
| Burnett ..... | 213 | 3 | 1.0 | .. |
| Untreated ..... | 191 | 174 | 90.5 | 0.5 |
| **BEECH.** | | | | |
| Straight Creosote .... | 484 | ... | .... | .. |
| Card ..... | 1226 | 18 | .... | 1.0 |
| Burnett ..... | 315 | 14 | 0.3 | 3.7 |
| Untreated ..... | 207 | 181 | 85.0 | 2.0 |
| **HICKORY.** | | | | |
| Straight Creosote .... | 25 | ... | .... | .. |
| Card ..... | 290 | 18 | 0.7 | 3.3 |
| Burnett ..... | 24 | ... | .... | .. |
| Untreated ..... | 110 | 88 | 76.0 | 4.0 |
| **POPLAR.** | | | | |
| Straight Creosote .... | 80 | ... | .... | .. |
| Card ..... | 645 | 38 | 1.0 | 5.0 |
| Burnett ..... | 80 | 2 | 1.5 | 1.5 |
| Untreated ..... | 125 | 108 | 83.0 | 3.0 |
| **HARD MAPLE.** | | | | |
| Straight Creosote .... | 116 | ... | .... | .. |
| Card ..... | 831 | 15 | 0.5 | 1.5 |
| Burnett ..... | 65 | 1 | .... | 2.0 |
| Untreated ..... | 121 | 111 | 91.0 | 1.0 |

(a) The above data do not include all the experimental ties in C. B. & Q. tracks.

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## Ties Placed in Experimental Tracks, C. B. & Q. Railroad, 1909-1910(a).

*(Continued.)*

| Process. | Total Placed. | Total Removed to Jan. 1917. | Per Cent. Removed Acct. Decay | Per Cent. Removed to Jan. 1917. Other Causes. |
|---|---|---|---|---|
| **PIN OAK.** | | | | |
| Straight Creosote .... | 321 | ... | .... | .. |
| Card ..... | 833 | 5 | .... | 1.0 |
| Burnett ..... | 68 | ... | .... | .. |
| Untreated ..... | 125 | 88 | 70.0 | .. |
| **LOBLOLLY OR SAP PINE.** | | | | |
| Straight Creosote .... | 205 | ... | .... | .. |
| Card ..... | 1344 | 74 | 2.0 | 4.0 |
| Burnett ..... | 200 | 17 | 5.0 | 4.0 |
| Untreated ..... | 249 | 208 | 83.0 | 1.0 |
| **CHESTNUT.** | | | | |
| Straight Creosote .... | .. | ... | .... | .. |
| Card ..... | 253 | 88 | .... | 35.0 |
| Burnett ..... | .. | ... | .... | .. |
| Untreated ..... | 258 | 95 | 8.0 | 29.0 |
| **RED OAK.** | | | | |
| Straight Creosote..... | 284 | 1 | .... | 0.4 |
| Card ..... | 1280 | 26 | 0.1 | 1.9 |
| Burnett ..... | 272 | 9 | 0.7 | 2.3 |
| Untreated ..... | 209 | 188 | 87.0 | 3.0 |
| **SYCAMORE.** | | | | |
| Straight Creosote..... | 90 | 1 | 1.0 | .. |
| Card ..... | 521 | 25 | 2.0 | 3.0 |
| Burnett ..... | 90 | 4 | 1.0 | 3.0 |
| Untreated ..... | 130 | 129 | 97.0 | 2.0 |
| **TAMARACK.** | | | | |
| Straight Creosote..... | 212 | ... | .... | .. |
| Card ..... | 1309 | 5 | 0.2 | 0.2 |
| Burnett ..... | 214 | 3 | .... | 1.0 |
| Untreated ..... | 175 | 159 | 90.0 | 1.0 |
| **TUPELO GUM.** | | | | |
| Straight Creosote..... | 151 | ... | ..... | .. |
| Card ..... | 671 | 10 | .... | 1.0 |
| Burnett ..... | 117 | 5 | 2.0 | 2.0 |
| Untreated ..... | 136 | 136 | 100.0 | .. |
| **WHITE OAK.** | | | | |
| Straight Creosote..... | 40 | ... | ..... | .. |
| Card ..... | 386 | 9 | .... | 2.0 |
| Burnett ..... | 43 | ... | ..... | .. |
| Untreated ..... | 124 | 13 | 10.0 | .. |

(a) The above data do not include all the experimental ties in C. B. & Q. tracks.

### SUMMARY.

| Process. | Total Placed. | Total Removed to Jan. 1917. | Per Cent. Removed Acct. Decay | Per Cent. Removed to Jan. 1917. Other Causes. |
|---|---|---|---|---|
| Straight Creosote..... | 3264 | 16 | 0.2 | 0.3 |
| Card ..... | 15817 | 455 | 0.4 | 2.5 |
| Burnett ..... | 2488 | 100 | 2.0 | 2.0 |
| Untreated ..... | 3270 | 2626 | 77.0 | 3.0 |

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TABLE 1.—SERVICE-TEST RECORDS OF CROSS-TIES—1916.

| Railroad | Reference Number | Creosote | | | | Untreated | Zinc Chloride Burnett | Zinc-Creosote | | | Zinc Tannin Wellhouse | Others | Species of Wood | Total Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Full Cell | Open Tank | Lowry | Rueping | | | Allardyce | Card | Not Stated etc. | | | | |
| A. C. Line | 49.00 | 1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 1 |
| A. T. & S. F. | 45.10 | ... | ... | ... | 17 | 2 | 4 | ... | ... | ... | ... | ... | 4 | 23 |
| B. & O. | 4.11 | 2 | ... | ... | ... | 3 | ... | ... | 2 | ... | ... | 1 | 4 | 8 |
| B. A. & P. | 24.00 | 1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 1 |
| C. & A. | 50.00 | ... | ... | ... | ... | ... | 1 | ... | ... | ... | ... | ... | 1 | 1 |
| C. & E. I. | 8.10 | ... | ... | 2 | ... | 1 | 13 | ... | ... | ... | 6 | 3 | 6 | 25 |
| C. & N. W. | 48 & 26 | ... | 2 | ... | ... | 9 | 5 | ... | 8 | ... | 56 | ... | 4 | 80 |
| C. & W. I. | 17.00 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 5 | ... | 1 | 5 |
| C. B. & Q. | 5.20 | 71 | 1 | 1 | 3 | 73 | 67 | 2 | 84 | ... | ... | 8 | 24 | 310 |
| C. I. & L. | 51.00 | ... | ... | 10 | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 10 |
| C. M. & St. P. | 6.11 & 27 | 4 | ... | ... | 4 | 18 | 15 | ... | 9 | 4 | ... | 5 | 14 | 59 |
| C. R. I. & P. | 36.00 | ... | ... | ... | ... | 2 | ... | ... | ... | ... | 1 | ... | 1 | 3 |
| D. L. & W. | 44.10 | 3 | ... | 7 | ... | 1 | ... | ... | ... | ... | ... | ... | 4 | 11 |
| Georgia | 34.00 | 2 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 2 |
| Great Northern | 40.10 | 2 | ... | ... | ... | 12 | 24 | ... | ... | ... | ... | ... | 7 | 38 |
| Illinois Central | 12.11 | ... | ... | ... | 14 | 7 | 12 | ... | ... | ... | ... | 4 | 9 | 27 |
| Indiana Railways (2) | 46.00 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 3 | 9 |
| L. & N. | 18.00 | 2 | ... | ... | ... | ... | 1 | ... | ... | ... | ... | ... | 2 | 3 |
| N. Y. Central | 14.10 | ... | ... | 26 | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 26 |
| N. Y., N. H. & H. | 38.10 | 3 | ... | ... | ... | ... | 2 | ... | ... | ... | ... | ... | 2 | 5 |
| Norfolk Southern | 16.10 | 2 | ... | ... | ... | 8 | ... | ... | ... | ... | 3 | ... | 3 | 13 |
| Northern Pacific | 19 & 25 | 16 | ... | 18 | 3 | 29 | 4 | ... | ... | ... | 3 | 5 | 16 | 68 |
| O. W. R. R. & N. | 28.00 | 1 | ... | ... | ... | 2 | 3 | ... | ... | ... | ... | 1 | 1 | 7 |
| Pennsylvania | 20.11 | 2 | ... | ... | 2 | 3 | ... | ... | ... | ... | ... | ... | 5 | 7 |
| P. S. & N. | 1.761 | ... | ... | ... | ... | 3 | ... | ... | ... | ... | ... | ... | 3 | 3 |
| Picatinny Arsenal | 28.00 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 2 | 2 |
| Q. & C. | 47.00 | 6 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4 | 6 |
| St. L. & S. F. | 30.20 | 3 | ... | ... | 3 | ... | ... | ... | ... | ... | ... | 2 | 2 | 8 |
| St. L. S. W. | 35.00 | 9 | ... | ... | ... | ... | ... | 2 | ... | ... | ... | ... | 5 | 11 |
| Southern Pacific | 32.10 | ... | ... | ... | ... | ... | 7 | ... | ... | ... | ... | 3 | 2 | 10 |
| Sunset Central (G. H. & S. A.) | 7.10 | 20 | ... | ... | ... | 12 | 14 | ... | ... | 13* | ... | 3 | 7 | 62 |
| Tenn. C. I. & Ry. | 21.00 | 2 | ... | ... | ... | 2 | ... | ... | ... | ... | ... | 4 | 3 | 8 |
| Total (33) | | 152 | 3 | 64 | 46 | 187 | 173 | 4 | 103 | 17 | 74 | 50 | 61 | 872 |

*Similar to Allardyce treatment.

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TABLE 2.—SERVICE TESTS OF CROSS-TIES—RESULTS OF 1916 INSPECTION.

| Treatment | Number of Species | Number of Records | | | Number of Railroads | | |
|---|---|---|---|---|---|---|---|
| | | Completed | Unfinished | Total | Completed | Unfinished | Total |
| Untreated ..... | 37 | 40† | 147 | 187 | 6 | 17 | 17 |
| Rueping ..... | 13 | .. | 46 | 46 | .. | 7 | 7 |
| Lowry ..... | 19 | .. | 64 | 64 | .. | 6 | 6 |
| Creosote (Full Cell or Bethell)* . | 31 | .. | 152 | 152 | .. | 19 | 19 |
| Creosote Open-Tank ..... | 3 | .. | 3 | 3 | .. | 2 | 2 |
| Zinc Chloride ..... | 32 | 7‡ | 165 | 172 | 3 | 13 | 14 |
| Card ..... | 24 | .. | 103 | 103 | 1 | 5 | 5 |
| Allardyce ..... | 4 | .. | 4 | 4 | .. | 2 | 2 |
| Wellhouse ..... | 6 | .. | 74 | 74 | .. | 6 | 6 |
| Others ..... | 20 | 6§ | 61 | 67 | 2 | 12 | 14 |
| Total ..... | 61 | 53 | 819 | 872 | 9 | 33 | 33 |

*Includes a few items such as "Creosote," Creosote Steamed," etc.
†18 species on 6 railways. ‡4 species on 3 railways. §5 species on 2 railways.

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## SUMMARY OF COMPLETED RECORDS.

| Species. | Number of Ties. | Set. Date | Treatment. | Railroad. | Average Life. Years. | Remarks. |
|---|---|---|---|---|---|---|
| Ash | 54 | 1909 | Untreated | C. B. & Q. | 4.6 | Lines East. |
| Beech | 48 | 1910 | Long's Liquid | I. C. | 4.25 | |
| Birch, red | 30 | 1910 | Untreated | C. B. & Q. | 3.4 | " West. |
| Cottonwood | 56 | 1909 | " | " | 2.6 | " East. |
| Cypress | 374 | 1895 | " | G. H. & S. A. | 15.2 | |
| " | 654 | 1895 | " | " | 15.2 | |
| Elm, white | 30 | 1910 | " | C. B. & Q. | 5.1 | " West. |
| Fir Douglas—(Coast) | 100 | 1906 | " | N. P. | 7.5* | Ave. life of 1078 seasoned ties, 8.4 years. Ave. life of 577 green ties, 8.3 years. |
| " " " | 45 mi. | 1903 | Burnett | S. P. | 10.11 | |
| " " " | 3.6 mi. | 1903 | " | " | 10.11 | |
| " " (Mountain)*** | 571 | 1907 | Untreated | N. P. | 7.7 | Seasoned ties. |
| " " " | 295 | 1907 | " | " | 7.6 | Green ties. |
| Gum, red | 45 | 1905 | Burnett | G. H. & S. A. | 6.7 | |
| " tupelo | 48 | 1909 | Untreated | C. B. & Q. | 4.0 | Lines West. |
| " " | 88 | 1909 | " | " | 2.9 | " East. |
| " " | 16 | 1905 | Zinc-Creosote | G. H. & S. A. | 8.5 | |
| Hemlock, eastern | 85 | 1909 | Untreated | C. B. & Q. | 4.2 | " " |
| " " | 20 | 1907 | " | C. & N. W. | 6.5 | |
| " " | 20 | 1907 | " | " | 6.3 | |
| " western | 100 | 1906 | " | N. P. | 7.3 | |
| " " | 103 | 1906 | " | " | 7.3 | |
| Larch | 92 | 1907 | " | " | 7.3** | Ave. life for 551 green ties is 7.3 years. |

*Laid with cut spikes and no tie-plates. (See remarks for average life of all ties in test.)
**Average life for all ties in test. (See remarks.)
***Subdivided into 10 records in the tables.

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SUMMARY OF COMPLETED RECORDS.—*(Continued).*

| Species. | Number of Ties. | Date Set. | Treatment. | Railroad. | Average Life. Years. | Remarks. |
|---|---|---|---|---|---|---|
| Larch | 90 | 1907 | Untreated | N. P. | 7.4** | Ave. life for 568 seasoned ties is 7.4 years. |
| " | 90 | 1907 | " | " | 7.4** | Ave. life for 568 seasoned ties is 7.4 years. |
| Maple, hard | 52 | 1909 | " | C. B. & Q. | 3.8 | Lines East. |
| " " | 30 | 1909 | " | " | 4.7 | " West. |
| " soft | 29 | 1909 | " | " | 4.1 | " " |
| " " | 14 | 1910 | " | " | 3.9 | " " |
| Oak, chestnut | 424 | 1904 | " | B. & O. | 7.7 | |
| " red | 9 | 1910 | Cresol-Calcium | I. C. | 4.0 | |
| " " | 50 | 1910 | Long's Liquid | " | 4.75 | |
| " " | 59 | 1909 | Untreated | C. B. & Q. | 5.0 | " " |
| " " | 1900 | 1907 | " | Penn. | 5.75 | |
| Pine, loblolly | 174 | 1910 | Long's Liquid | I. C. | 5.5 | |
| " longleaf | 184 | 1905 | Untreated | G. H. & S. A. | 4.0 | |
| " " | 67 | 1901 | Burnett | N. Y., N. H. & H. | 14.8 | |
| " " | 68 | 1901 | " | " | 14.4 | |
| " sap | 334 | 1905 | " | G. H. & S. A. | 5.4 | Laid with screw spikes. |
| " " | 334 | 1905 | " | " | 5.7 | Laid with cut spikes, without tie-plates. |
| " southern yellow | 1095 | 1895 | Zinc-Creosote | " | 15.6 | |
| Sycamore | 15 | 1910 | Untreated | C. B. & Q. | 3.9 | Lines West. |
| " | 25 | 1910 | " | " | 3.2 | " East. |
| Tamarack | 47 | 1909 | " | " | 4.9 | " West. |
| " | 85 | 1909 | " | " | 4.7 | " East. |
| " | 62 | 1907 | " | C. & N. W. | 6.5 | |

*Laid with cut spikes and no tie-plates. (See remarks for average life of all ties in test.)
**Average life for all ties in the test. (See remarks.)
***Subdivided into 10 records in the tables.

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## Cross-Tie Records—Service Tests.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | ASH. | | | | | | |
| | | | | | | CREOS | OTE—(FUL | L-CELL). | | | | | |
| 1.1 | | | | 19 | | | | 9.62 | 1910 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 1 | | | | 9.62 | 1909 | " | " West | | |
| 1.3 | | | | 15 | | | | 9.62 | 1910 | " | " " | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8 | Hewed | Seasoned | 44 | Minn. | 19 to Rl. | 22.8 | 6.50 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech, Index | Nos. 3.2-3.3 | .) | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 54 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 14 | | | | | 1910 | " | " " | | |
| 3.3 | | | | 30 | | | | | 1909 | " | " West | | |
| 3.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.1 | 0). | | | | |
| 4.1 | | | | 16 | | | | 0.50 | 1910 | C.B.&Q. | Lines East | | |
| 4.2 | | | Seasoned 1 year | 15 | | | | 0.50 | 1910 | " | " West | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 148 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 123 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 88 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 5.4 | | | | 15 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.5 | 6x8x8 | | | 325 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |

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| Index No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ASH—(*Continued*). | | | | | | | | | | |
| | | | | | CREOSOTE—(FULL-CELL). | | | | | | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Burnt Clay & Cin. | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.2 | Yes | | " | 85 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.3 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | CREOSOTE—(FLOW-RY). | | | | | | | | | | |
| 2.1 | Flat | 6x8½ 9/16 | " | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | O. K. | | | 19.00 |
| | | | | | CREOSOTE—(REPEATING). | | | | | | | | | | |
| | | | | | (See Beech, Index Nos. 3.2-3.3). | | | | | | | | | | |
| | | | | | UNTREATED. | | | | | | | | | | |
| 3.1 | Yes | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 100.00 | | | | 4.6 | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6. | 71.40 | | | | | | 5.20 |
| 3.2 | Yes | | " | 75-85-90 | Cin., Gr., Rock | | 1915 | 6. | 100.00 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Burnt Clay | | 1916 | 6. | 60.00 | | | | | | 5.20 |
| | | | | | ZINC CHLORIDE—(BURNETT). | | | | | | | | | | |
| | | | | | (See Beech Index Nos. 9.8-9.10). | | | | | | | | | | |
| 4.1 | All | | Cut | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.2 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZINC-CREOSOTE | TE—(CAR D). | | | | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 6.30 | | | | | | 5.20 |
| 5.2 | " | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.30 | | | | | | 5.20 |
| 5.4 | " | | " | 75-85-90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.5 | | | | 90 | Slag | | 1916 | 8. | 2.10 | | | | | | 48.00 |



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## Cross-Tie Records—Service Tests—(Continued).

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | BEECH. | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 206 | | | | 11.12 | 1909 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 99 | | | | 11.12 | 1910 | " | " " | | |
| 1.3 | | | | 119 | | | | 11.12 | 1909 | " | " West | | |
| 1.4 | | | | 44 | | | | 11.12 | 1910 | " | " " | | |
| 1.5 | 7x9x8½ | Hewed Sawed | Peeled Seasoned | 250 | | | Gal. 2.5 | Gal. 0.675 | 1911 | B.&O. | Windsor, O. | | |
| 1.6 | 7x9x8½ | | Steamed | 255 | | | | | 1908 | D.L.&W. | Boonton, N. J. | | |
| | | | | | | CR | EOSOTE—( | GIUSSANI | ). | | | | |
| | | | | | | ( | See Oak Index | No. 14.1.) | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8½ | | Seasoned | 812 | | | Gal. 5 | | 1913 | D.L.&W. | Paterson, N. J. | | |
| 2.2 | 7x9x8½ | | " | 158,000 | | | Gal. 3.5 | | 1910-11 | D.L.&W. | Cut-off | | |
| 2.3 | 6x8x8 | Sawed | " | 198 | Ind. | 20" | 18.7 | 7.0 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | .5 |
| 2.4 | 6x8x8 | Hewed | " | 198 | " | 20" | 30.1 | 11.3 | 1914 | " | " | " | .5 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 3.1 | 6x8x8 | Sawed Hewed | | 202 | | | | 5.0 | 1909 | I.C. | Kankakee, Ill. | | |
| 3.2 | 6x8x8 | Sawed Hewed | Well Seasoned | 274 | | | | 5.0 | 1909 | " | Fulton, Ky. | | |
| 3.3 | 6x8x8 | Sawed Hewed | " | 274 | | | | 5.0 | 1910 | " | Greenville, Miss. | | |
| 3.4 | 6x8x8 | Sawed Hewed | | 248 | | | | | 1910 | " | Bloomington, Ill. | | |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 4.1 | | | | 5 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BEECH— | (*Contin | *ued* | ). | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 85-90 | Cin.,Gr.,Bt.C.,Rk | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.5 | Shoulder Flange | | " | 90 | Gravel | 10,586,000 | 1916 | 5. | 0 | | | 98.8% Good | | 1.2% Decayed. Includes gum | 4.11 |
| 1.6 | Wal-haupter | | " | 101 | Stone | | 1916 | 8. | 0 | | | | | Includes birch and maple | 44.10 |
| | | | | | CREOSOTE—(G | IUSSAN (See Oak | I). Ind | ex | No. 14 | .1). | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 3. | 0 | | | | | Includes birch and maple | 44.10 |
| 2.2 | " | | " | 101-91 | " | | 1916 | 4 & 5 | 0 | | | | | | 44.10 |
| 2.3 | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913 Placed, June, 1914. | 51.00 |
| 2.4 | " | 7 | " | 90 | " | 5,297,567 | 1916 | 2. | 0 | | | " | | | 51.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 3.1 | Sellers | 6x8 | Cut | 90 | Stone | | 1916 | 7. | 11.40 | | | | | Removed acct. derailment. 50% tie plated. Includes gum. | 12.11 |
| 3.2 | " | 6x8 | " | 90 | Gravel | | 1916 | 7. | 3.30 | | 3.30 | * | | Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 3.3 | " | 6x8 | " | 75 | Dirt, Gr., Since | | 1916 | 6. | 1.80 | | 1.80 | | | *Worn out and split, badly creeping track. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 3.4 | " | 6x8 | " | 75 | Gravel | | 1916 | 6. | 0 | | | | | 50% tie plated. Includes chestnut, elm and gum. | 12.11 |
| | | | | | CR | EOSOTE | AN | D C | RUD | E OI | L. | | | | |
| 4.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie plates under joints | 5.20 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | CRE | OSOTE, | BEECH— 80%; TAR, | *(Continue* 20%—(LO | *d).* WRY). | | | | |
| 5.1 | 6x8x8 | Sawed | Seasoned 6 mos. | 1,507 | Ill. | | 8.46 | 2.54 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| | | | | | | | CRUDE OIL. | | | | | | |
| 6.1 | | | | 6 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | J. M. LONG'S | LIQUID. | | | | | |
| 7.1 | | | Seasoned | 48 | | | | 0.287 | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 8.1 | | | | 110 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 8.2 | | | | 23 | | | | | 1910 | " | " " | | |
| 8.3 | | | | 58 | | | | | 1909 | " | " West | | |
| 8.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 9.1 | | | | 106 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 9.2 | | | | 104 | | | | 0.50 | 1910 | " | " " | | |
| 9.3 | | | | 60 | | | | 0.50 | 1909 | " | " West | | |
| 9.4 | | | | 44 | | | | 0.50 | 1910 | " | " " | | |
| 9.5 | 6x8x8 | Sawed | Air-Seasoned | 500 | | 18 to Rl. | 1⅛ | 0.50 | 1911 | C.M.& St.P. | Minneiska, Minn. | " | 0 |
| 9.6 | 6x8x8 | Sawed | Seasoned 8 mos. | 28 | Ky. | | 1.417 | .511 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 9.7 | 6x8x8 | Hewed | Seasoned 8 mos. | 775 | " | | 1.417 | .511 | 1912 | " | " | | |
| 9.8 | 6x8x8 | Sawed Hewed | Seasoned | 274 | | | | 0.50 | 1909 | I.C. | Kankakee, Ill. | | |

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| Service Conditions—*(Continued)*: | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CREOSOT | BEEC E, 80%; | H TA | —( R, | *Con* 20%— | *tinu* (LO | *ed*). WR | Y). | | | |
| 5.1 | | | | | | | 1916 | 4. | 0 | | | | | Ave. sapwood, 50% | 8.10 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 6.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie plates under joints | 5.20 |
| | | | | | | J. M. | LO | NG' | S LIQ | UID. | | | | | |
| 7.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 100.00 | 100.00 | | | 4½ | 50% tie plated | 12.11 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 8.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.40 | | | | | | 5.20 |
| 8.2 | " | | " | 90 | Gravel | | 1916 | 6. | 65.20 | | | | | | 5.20 |
| 8.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.60 | | | | | | 5.20 |
| 8.4 | " | | " | 75-85-90 | " | | 1916 | 6. | 26.70 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 9.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 11.30 | | | | | | 5.20 |
| 9.2 | All | | " | 90 | Cinders | | 1916 | 6. | 1.00 | | | | | | 5.20 |
| 9.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.70 | | | | | | 5.20 |
| 9.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 9.5 | None | | Cut | 90 | Gravel | Heavy | 1916 | 5. | 0.20 | 0.20 | | 94.4% Very Good | | Steamed before treatment. | 6.11 |
| 9.6 | | | | | | | 1916 | 4. | 0 | | | | | Treated ties stacked in open piles 26 days before setting. Ave. sapwood, 20%. | 8.10 |
| 9.7 | | | | | | | 1916 | 4. | 0 | | | | | Ave. sapwood, 20%. Treated ties stacked in open piles 26 days before setting. | 8.10 |
| 9.8 | Sellers | 6x8 | Cut | 90 | Stone | | 1916 | 7. | 24.10 | | | | | Removed acct. derailment. Includes ash, elm, gum, chestnut and maple. 50% tie plated. | 12.11 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | ZINC | CHLOR | BEECH—IDE—(BUR | (*Continued*). NETT). | | | | | |
| 9.9 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1910 | I.C. | Bloomington, Ill. | | |
| 9.10 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1909 | " | Fulton, Ky. | | |
| 9.11 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1910 | " | Greenville, Miss. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 10.1 | | | | 433 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 10.2 | | | | 370 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " " | | |
| 10.3 | | | | 37 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | " " | | |
| 10.4 | | | | 240 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 10.5 | | | | 177 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 10.6 | 7x9x8½ | Sawed Hewed | Peeled Seasoned | 1,107 | | | | Zn. 0.50 Cre. 2.00 | 1911 | B.&O. | Windsor, O. | | |
| 10.7 | 6x8x8 | Sawed | Seasoned 8 mos. | 162 | N. Wis. | 19 to Rl. | 6.6 | Zn. 0.50 Cre. 2.00 | 1912 | C.M.& St. P. | Lake Wis. | Tang. | 0 |
| 10.8 | 6x8x8 | | | 125 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | CR | BIR EOSOTE—( (See | CH. FULL-CEL L). Birch Index No. 1.6). | | | | | |

| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Ser-vice | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | | BEEC | H | —( | *Con* | *tinu* | *ed*). | | | | |
| 9.9 | " | 6x8 | " | 75 | Gravel | | 1916 | 6. | 0 | | | | | Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 9.10 | " | 6x8 | " | 90 | " | | 1916 | 7. | 8.40 | | 8.40 | | | Includes ash, elm, gum, chestnut and maple. Worn out and split, badly creeping track. Badly checked and spikes worn. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 9.11 | " | 6x8 | " | 75 | Dirt Gravel since 1912 | | 1916 | 6. | 10.50 | | | | | Badly checked and spike worn. 50% tie-plated. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 10.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.50 | | | | | | 5.20 |
| 10.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 7. | 0 | | | | | | 5.20 |
| 10.3 | Yes | | " | 75 | " | | 1916 | 5. | 0 | | | | | | 5.20 |
| 10.4 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.90 | | | | | | | 5.20 |
| 10.5 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 10.6 | Shoulder Flanges | | " | 90 | Gravel | Heavy | 1916 | 5. | 0 | | | 99.2% good | | 0.8% Decayed. Includes gum. | 4.11 |
| 10.7 | None | | " | 85 | Cinder | Light | 1916 | 4. | 0 | | | good | | Sawed boxed heart. | 6.11 |
| 10.8 | | | | 90 | Slag | | 1916 | 8. | 2.40 | | | | | | 48.00 |
| | | | | | | | BI | RC | H. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| | | | | | (See Birch Index | No. 1.6). | | | | | | | | | |



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**Ties Placed in Experimental Tracks, C. B. & Q. Railroad, 1909-1910(a).**

| Process. | Total Placed. | Total Removed to Jan. 1917. | Per Cent. Removed Acct. Decay | Per Cent. Removed to Jan. 1917. Other Causes. |
|---|---|---|---|---|
| **ASH.** | | | | |
| Straight Creosote .... | 35 | ... | .... | .. |
| Card ..... | 388 | 12 | 0.5 | 2.5 |
| Burnett ..... | 31 | ... | .... | .. |
| Untreated..... .. | 116 | 103 | 87.0 | 1.7 |
| **BIRCH.** | | | | |
| Straight Creosote .... | 133 | ... | .... | .. |
| Card ..... | 1075 | 20 | 0.3 | 1.7 |
| Burnett ..... | 103 | 3 | 1.9 | 1.1 |
| Untreated ..... | 217 | 217 | 98.0 | .. |
| **CYPRESS.** | | | | |
| Straight Creosote .... | 54 | ... | .... | .. |
| Card ..... | 662 | 6 | 0.2 | 0.8 |
| Burnett ..... | 55 | ... | .... | .. |
| Untreated ..... | 225 | 115 | 51.0 | .. |
| **COTTONWOOD.** | | | | |
| Straight Creosote .... | 133 | ... | .... | .. |
| Card ..... | 456 | 8 | .... | 2.0 |
| Burnett ..... | .. | ... | .... | .. |
| Untreated ..... | 86 | 86 | 96.0 | 4.0 |
| **ELM.** | | | | |
| Straight Creosote .... | 328 | 7 | 0.7 | 1.3 |
| Card ..... | 957 | 12 | 0.5 | 0.5 |
| Burnett ..... | 297 | 6 | 0.7 | 1.3 |
| Untreated ..... | 190 | 163 | 82.0 | 4.0 |
| **SOFT MAPLE.** | | | | |
| Straight Creosote .... | 201 | 4 | 0.5 | 1.5 |
| Card ..... | 731 | 28 | 0.5 | 3.5 |
| Burnett ..... | 182 | 9 | 1.0 | 4.0 |
| Untreated ..... | 125 | 122 | 98.0 | .. |
| **RED GUM.** | | | | |
| Straight Creosote .... | 137 | 2 | .... | 1.0 |
| Card ..... | 661 | 17 | 1.0 | 2.0 |
| Burnett ..... | 119 | 24 | 15.0 | 5.0 |
| Untreated ..... | 151 | 147 | 96.0 | 1.0 |
| **HEMLOCK.** | | | | |
| Straight Creosote .... | 235 | 1 | .... | 4.0 |
| Card ..... | 1298 | 26 | 0.1 | 1.9 |
| Burnett ..... | 213 | 3 | 1.0 | .. |
| Untreated ..... | 191 | 174 | 90.5 | 0.5 |
| **BEECH.** | | | | |
| Straight Creosote .... | 484 | ... | .... | .. |
| Card ..... | 1226 | 18 | .... | 1.0 |
| Burnett ..... | 315 | 14 | 0.3 | 3.7 |
| Untreated ..... | 207 | 181 | 85.0 | 2.0 |
| **HICKORY.** | | | | |
| Straight Creosote .... | 25 | ... | .... | .. |
| Card ..... | 290 | 13 | 0.7 | 3.3 |
| Burnett ..... | 24 | ... | .... | .. |
| Untreated ..... | 110 | 88 | 76.0 | 4.0 |
| **POPLAR.** | | | | |
| Straight Creosote .... | 80 | ... | .... | .. |
| Card ..... | 645 | 38 | 1.0 | 5.0 |
| Burnett ..... | 80 | 2 | 1.5 | 1.5 |
| Untreated ..... | 125 | 108 | 83.0 | 3.0 |
| **HARD MAPLE.** | | | | |
| Straight Creosote .... | 116 | ... | .... | .. |
| Card ..... | 831 | 15 | 0.5 | 1.5 |
| Burnett ..... | 65 | 1 | .... | 2.0 |
| Untreated ..... | 121 | 111 | 91.0 | 1.0 |

(a) The above data do not include all the experimental ties in C. B. & Q. tracks.

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## Ties Placed in Experimental Tracks, C. B. & Q. Railroad, 1909-1910(a).

*(Continued.)*

| Process. | Total Placed. | Total Removed to Jan. 1917. | Per Cent. Removed Acct. Decay | Per Cent. Removed to Jan. 1917. Other Causes. |
|---|---|---|---|---|
| **PIN OAK.** | | | | |
| Straight Creosote .... | 321 | ... | .... | .. |
| Card ..... | 833 | 5 | .... | 1.0 |
| Burnett ..... | 68 | ... | .... | .. |
| Untreated ..... | 125 | 88 | 70.0 | .. |
| **LOBLOLLY OR SAP PINE.** | | | | |
| Straight Creosote .... | 205 | ... | .... | .. |
| Card ..... | 1344 | 74 | 2.0 | 4.0 |
| Burnett ..... | 200 | 17 | 5.0 | 4.0 |
| Untreated ..... | 249 | 208 | 83.0 | 1.0 |
| **CHESTNUT.** | | | | |
| Straight Creosote .... | .. | ... | .... | .. |
| Card ..... | 253 | 88 | .... | 35.0 |
| Burnett ..... | .. | ... | .... | .. |
| Untreated ..... | 258 | 95 | 8.0 | 29.0 |
| **RED OAK.** | | | | |
| Straight Creosote..... | 284 | 1 | .... | 0.4 |
| Card ..... | 1280 | 26 | 0.1 | 1.9 |
| Burnett ..... | 272 | 9 | 0.7 | 2.3 |
| Untreated ..... | 209 | 188 | 87.0 | 3.0 |
| **SYCAMORE.** | | | | |
| Straight Creosote..... | 90 | 1 | 1.0 | .. |
| Card ..... | 521 | 25 | 2.0 | 3.0 |
| Burnett ..... | 90 | 4 | 1.0 | 3.0 |
| Untreated ..... | 130 | 129 | 97.0 | 2.0 |
| **TAMARACK.** | | | | |
| Straight Creosote..... | 212 | ... | .... | .. |
| Card ..... | 1309 | 5 | 0.2 | 0.2 |
| Burnett ..... | 214 | 3 | .... | 1.0 |
| Untreated ..... | 175 | 159 | 90.0 | 1.0 |
| **TUPELO GUM.** | | | | |
| Straight Creosote..... | 151 | ... | ..... | .. |
| Card ..... | 671 | 10 | .... | 1.0 |
| Burnett ..... | 117 | 5 | 2.0 | 2.0 |
| Untreated ..... | 136 | 136 | 100.0 | .. |
| **WHITE OAK.** | | | | |
| Straight Creosote..... | 40 | ... | ..... | .. |
| Card ..... | 386 | 9 | .... | 2.0 |
| Burnett ..... | 43 | ... | ..... | .. |
| Untreated ..... | 124 | 13 | 10.0 | .. |

(a) The above data do not include all the experimental ties in C. B. & Q. tracks.

### SUMMARY.

| Process. | Total Placed. | Total Removed to Jan. 1917. | Per Cent. Removed Acct. Decay | Per Cent. Removed to Jan. 1917. Other Causes. |
|---|---|---|---|---|
| Straight Creosote..... | 3264 | 16 | 0.2 | 0.3 |
| Card ..... | 16817 | 455 | 0.4 | 2.5 |
| Burnett ..... | 2488 | 100 | 2.0 | 2.0 |
| Untreated ..... | 3270 | 2626 | 77.0 | 3.0 |

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TABLE 1.—SERVICE-TEST RECORDS OF CROSS-TIES—1916.

| Railroad | Reference Number | Creosote | | | | Untreated | Zinc Chloride Burnett | Zinc-Creosote | | | Zinc Tannin Wellhouse | Others | Species of Wood | Total Number |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Full Cell | Open Tank | Lowry | Rueping | | | Allardyce | Card | Not Stated etc. | | | | |
| A. C. Line | 49.00 | 1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 1 |
| A. T. & S. F. | 45.10 | ... | ... | ... | 17 | 2 | 4 | ... | ... | ... | ... | ... | 4 | 23 |
| B. & O. | 4.11 | 2 | ... | ... | ... | 3 | ... | ... | 2 | ... | ... | 1 | 4 | 8 |
| B. A. & P. | 24.00 | 1 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 1 |
| C. & A. | 50.00 | ... | ... | ... | ... | ... | 1 | ... | ... | ... | ... | ... | 1 | 1 |
| C. & E. I. | 8.10 | ... | ... | 2 | ... | 1 | 13 | ... | ... | ... | 6 | 3 | 6 | 25 |
| C. & N. W. | 48 & 26 | ... | 2 | ... | ... | 9 | 5 | ... | 8 | ... | 56 | ... | 4 | 80 |
| C. & W. I. | 17.00 | ... | ... | ... | ... | ... | ... | ... | ... | ... | 5 | ... | 1 | 5 |
| C. B. & Q. | 5.20 | 71 | 1 | 1 | 3 | 73 | 67 | 2 | 84 | ... | ... | 8 | 24 | 310 |
| C. I. & L. | 51.00 | ... | ... | 10 | ... | ... | ... | ... | ... | ... | ... | ... | 8 | 10 |
| C. M. & St. P. | 6.11 & 27 | 4 | ... | ... | 4 | 18 | 15 | ... | 9 | 4 | ... | 5 | 14 | 59 |
| C. R. I. & P. | 36.00 | ... | ... | ... | ... | 2 | ... | ... | ... | ... | 1 | ... | 1 | 3 |
| D. L. & W. | 44.10 | 3 | ... | 7 | ... | 1 | ... | ... | ... | ... | ... | ... | 4 | 11 |
| Georgia | 34.00 | 2 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 1 | 2 |
| Great Northern | 40.10 | 2 | ... | ... | ... | 12 | 24 | ... | ... | ... | ... | ... | 7 | 38 |
| Illinois Central | 12.11 | ... | ... | ... | 14 | 7 | 12 | ... | ... | ... | ... | 4 | 9 | 37 |
| Indiana Railways (2) | 46.00 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 9 | 3 | 9 |
| L. & N. | 18.00 | 2 | ... | ... | ... | ... | 1 | ... | ... | ... | ... | ... | 2 | 3 |
| N. Y. Central | 14.10 | ... | ... | 26 | ... | ... | ... | ... | ... | ... | ... | ... | 3 | 26 |
| N. Y., N. H. & H. | 38.10 | 3 | ... | ... | ... | ... | 2 | ... | ... | ... | ... | ... | 2 | 5 |
| Norfolk Southern | 16.10 | 2 | ... | ... | ... | 8 | ... | ... | ... | ... | 3 | ... | 2 | 13 |
| Northern Pacific | 19 & 25 | 16 | ... | 18 | 3 | 29 | 4 | ... | ... | ... | 3 | 5 | 16 | 68 |
| O. W. R. R. & N. | 28.00 | 1 | ... | ... | ... | 2 | 3 | ... | ... | ... | ... | 1 | 1 | 7 |
| Pennsylvania | 20.11 | 2 | ... | ... | 2 | 3 | ... | ... | ... | ... | ... | ... | 5 | 7 |
| P. S. & N. | 1.761 | ... | ... | ... | ... | 3 | ... | ... | ... | ... | ... | ... | 2 | 3 |
| Picatinny Arsenal | 28.00 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 2 | 2 | 2 |
| Q. & C. | 47.00 | 6 | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4 | 6 |
| St. L. & S. F. | 30.20 | 3 | ... | ... | 3 | ... | ... | ... | ... | ... | ... | 2 | 2 | 8 |
| St. L. S. W. | 35.00 | 9 | ... | ... | ... | ... | ... | 2 | ... | ... | ... | ... | 5 | 11 |
| Southern Pacific | 32.10 | ... | ... | ... | ... | ... | 7 | ... | ... | ... | ... | 3 | 2 | 10 |
| Sunset Central (G. H. & S. A.) | 7.10 | 20 | ... | ... | ... | 12 | 14 | ... | ... | 13* | ... | 3 | 7 | 62 |
| Tenn. C. I. & Ry. | 21.00 | 2 | ... | ... | ... | 2 | ... | ... | ... | ... | ... | 4 | 3 | 8 |
| Total (33) | | 152 | 3 | 64 | 46 | 187 | 173 | 4 | 103 | 17 | 74 | 50 | 61 | 872 |

*Similar to Allardyce treatment.

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TABLE 2.—SERVICE TESTS OF CROSS-TIES—RESULTS OF 1916 INSPECTION.

| Treatment | Number of Species | Number of Records | | | Number of Railroads | | |
|---|---|---|---|---|---|---|---|
| | | Completed | Unfinished | Total | Completed | Unfinished | Total |
| Untreated | 37 | 40† | 147 | 187 | 6 | 17 | 17 |
| Rueping | 13 | .. | 46 | 46 | .. | 7 | 7 |
| Lowry | 19 | .. | 64 | 64 | .. | 6 | 6 |
| Creosote (Full Cell or Bethell)* | 31 | .. | 152 | 152 | .. | 19 | 19 |
| Creosote Open-Tank | 3 | .. | 3 | 3 | .. | 2 | 2 |
| Zinc Chloride | 32 | 7‡ | 165 | 172 | 3 | 13 | 14 |
| Card | 24 | .. | 103 | 103 | 1 | 5 | 5 |
| Allardyce | 4 | .. | 4 | 4 | .. | 2 | 2 |
| Wellhouse | 6 | .. | 74 | 74 | .. | 6 | 6 |
| Others | 20 | 6§ | 61 | 67 | 2 | 12 | 14 |
| Total | 61 | 53 | 819 | 872 | 9 | 33 | 33 |

*Includes a few items such as "Creosote," Creosote Steamed," etc.
†18 species on 6 railways. ‡4 species on 3 railways. §5 species on 2 railways.

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## SUMMARY OF COMPLETED RECORDS.

| Species. | Number of Ties. | Set. Date | Treatment. | Railroad. | Average Life. Years. | Remarks. |
|---|---|---|---|---|---|---|
| Ash | 54 | 1909 | Untreated | C. B. & Q. | 4.6 | Lines East. |
| Beech | 48 | 1910 | Long's Liquid | I. C. | 4.25 | |
| Birch, red | 30 | 1910 | Untreated | C. B. & Q. | 3.4 | " West. |
| Cottonwood | 56 | 1909 | " | " | 2.6 | " East. |
| Cypress | 374 | 1895 | " | G. H. & S. A. | 15.2 | |
| " | 654 | 1895 | " | " | 15.2 | |
| Elm, white | 30 | 1910 | " | C. B. & Q. | 5.1 | " West. |
| Fir Douglas—(Coast) | 100 | 1906 | " | N. P. | 7.5* | Ave. life of 1078 seasoned ties, 8.4 years. Ave. life of 577 green ties, 8.3 years. |
| " " " | 45 mi. | 1903 | Burnett | S. P. | 10.11 | |
| " " " | 3.6 mi. | 1903 | " | " | 10.11 | |
| " " (Mountain)*** | 571 | 1907 | Untreated | N. P. | 7.7 | Seasoned ties. |
| " " " | 295 | 1907 | " | " | 7.6 | Green ties. |
| Gum, red | 45 | 1905 | Burnett | G. H. & S. A. | 6.7 | |
| " tupelo | 48 | 1909 | Untreated | C. B. & Q. | 4.0 | Lines West. |
| " " | 88 | 1909 | " | " | 2.9 | " East. |
| " " | 16 | 1905 | Zinc-Creosote | G. H. & S. A. | 8.5 | |
| Hemlock, eastern | 85 | 1909 | Untreated | C. B. & Q. | 4.2 | " " |
| " " | 20 | 1907 | " | C. & N. W. | 6.5 | |
| " " | 20 | 1907 | " | " | 6.3 | |
| " western | 100 | 1906 | " | N. P. | 7.3 | |
| " " | 103 | 1906 | " | " | 7.3 | |
| Larch | 92 | 1907 | " | " | 7.3** | Ave. life for 551 green ties is 7.3 years. |

*Laid with cut spikes and no tie-plates. (See remarks for average life of all ties in test.)
**Average life for all ties in test. (See remarks.)
***Subdivided into 10 records in the tables.

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SUMMARY OF COMPLETED RECORDS.—*(Continued).*

| Species. | Number of Ties. | Date Set. | Treatment. | Railroad. | Average Life. Years. | Remarks. |
|---|---|---|---|---|---|---|
| Larch | 90 | 1907 | Untreated | N. P. | 7.4** | Ave. life for 568 seasoned ties is 7.4 years. |
| " | 90 | 1907 | " | " | 7.4** | Ave. life for 568 seasoned ties is 7.4 years. |
| Maple, hard | 52 | 1909 | " | C. B. & Q. | 3.8 | Lines East. |
| " " | 30 | 1909 | " | " | 4.7 | " West. |
| " soft | 29 | 1909 | " | " | 4.1 | " " |
| " " | 14 | 1910 | " | " | 3.9 | " " |
| Oak, chestnut | 424 | 1904 | " | B. & O. | 7.7 | |
| " red | 9 | 1910 | Cresol-Calcium | I. C. | 4.0 | |
| " " | 50 | 1910 | Long's Liquid | " | 4.75 | |
| " " | 59 | 1909 | Untreated | C. B. & Q. | 5.0 | " " |
| " " | 1900 | 1907 | " | Penn. | 5.75 | |
| Pine, loblolly | 174 | 1910 | Long's Liquid | I. C. | 5.5 | |
| " longleaf | 184 | 1905 | Untreated | G. H. & S. A. | 4.0 | |
| " " | 67 | 1901 | Burnett | N. Y., N. H. & H. | 14.8 | |
| " " | 68 | 1901 | " | " | 14.4 | |
| " sap | 334 | 1905 | " | G. H. & S. A. | 5.4 | Laid with screw spikes. |
| " " | 334 | 1905 | " | " | 5.7 | Laid with cut spikes, without tie-plates. |
| " southern yellow | 1095 | 1895 | Zinc-Creosote | " | 15.6 | |
| Sycamore | 15 | 1910 | Untreated | C. B. & Q. | 3.9 | Lines West. |
| " | 25 | 1910 | " | " | 3.2 | " East. |
| Tamarack | 47 | 1909 | " | " | 4.9 | " West. |
| " | 85 | 1909 | " | " | 4.7 | " East. |
| " | 62 | 1907 | " | C. & N. W. | 6.5 | |

*Laid with cut spikes and no tie-plates. (See remarks for average life of all ties in test.)
**Average life for all ties in the test. (See remarks.)
***Subdivided into 10 records in the tables.

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| " " | ..... | Cypress | 114, 115 |
| " " | ..... | Elm, white | 118, 119 |
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## Cross-Tie Records—Service Tests.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | ASH. | | | | | | |
| | | | | | | CREOS | OTE—(FUL | L-CELL). | | | | | |
| 1.1 | | | | 19 | | | | 9.62 | 1910 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 1 | | | | 9.62 | 1909 | " | " West | | |
| 1.3 | | | | 15 | | | | 9.62 | 1910 | " | " " | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8 | Hewed | Seasoned | 44 | Minn. | 19 to Rl. | 22.8 | 6.50 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech, Index | Nos. 3.2-3.3 | .) | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 54 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 14 | | | | | 1910 | " | " " | | |
| 3.3 | | | | 30 | | | | | 1909 | " | " West | | |
| 3.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.1 | 0). | | | | |
| 4.1 | | | | 16 | | | | 0.50 | 1910 | C.B.&Q. | Lines East | | |
| 4.2 | | | Seasoned 1 year | 15 | | | | 0.50 | 1910 | " | " West | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 148 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 123 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 88 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 5.4 | | | | 15 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.5 | 6x8x8 | | | 325 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |

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| Index No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ASH—(*Continued*). | | | | | | | | | | |
| | | | | | CREOSOTE—(FULL-CELL). | | | | | | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Burnt Clay & Cin. | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.2 | Yes | | " | 85 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.3 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | CREOSOTE—(FULL-CELL). | | | | | | | | | | |
| 2.1 | Flat | 6x8½ 9/16 | " | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | O. K. | | | 19.00 |
| | | | | | CREOSOTE—(FULL-CELL). | | | | | | | | | | |
| | | | | | (See Beech, Index Nos. 3.2-3.3). | | | | | | | | | | |
| | | | | | UNTREATED. | | | | | | | | | | |
| 3.1 | Yes | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 100.00 | | | | 4.6 | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6. | 71.40 | | | | | | 5.20 |
| 3.2 | Yes | | " | 75-85-90 | Cin., Gr., Rock | | 1915 | 6. | 100.00 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Burnt Clay | | 1916 | 6. | 60.00 | | | | | | 5.20 |
| | | | | | ZINC CHLORIDE—(BURNETTIZING). | | | | | | | | | | |
| | | | | | (See Beech Index Nos. 9.8-9.10). | | | | | | | | | | |
| 4.1 | All | | Cut | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.2 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZINC-CREOSOTE—(CARD). | | | | | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 6.30 | | | | | | 5.20 |
| 5.2 | " | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.30 | | | | | | 5.20 |
| 5.4 | " | | " | 75-85-90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.5 | | | | 90 | Slag | | 1916 | 8. | 2.10 | | | | | | 48.00 |



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## Cross-Tie Records—Service Tests—(Continued).

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | BEECH. | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 206 | | | | 11.12 | 1909 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 99 | | | | 11.12 | 1910 | " | " " | | |
| 1.3 | | | | 119 | | | | 11.12 | 1909 | " | " West | | |
| 1.4 | | | | 44 | | | | 11.12 | 1910 | " | " " | | |
| 1.5 | 7x9x8½ | Hewed Sawed | Peeled Seasoned | 250 | | | Gal. 2.5 | Gal. 0.675 | 1911 | B.&O. | Windsor, O. | | |
| 1.6 | 7x9x8½ | | Steamed | 255 | | | | | 1908 | D.L.&W. | Boonton, N. J. | | |
| | | | | | | CR ( | EOSOTE—( See Oak Index | GIUSSANI No. 14.1.) | ). | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8½ | | Seasoned | 812 | | | Gal. 5 | | 1913 | D.L.&W. | Paterson, N. J. | | |
| 2.2 | 7x9x8½ | | " | 158,000 | | | Gal. 3.5 | | 1910-11 | D.L.&W. | Cut-off | | |
| 2.3 | 6x8x8 | Sawed | " | 198 | Ind. | 20" | 18.7 | 7.0 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | .5 |
| 2.4 | 6x8x8 | Hewed | " | 198 | " | 20" | 30.1 | 11.3 | 1914 | " | " | " | .5 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 3.1 | 6x8x8 | Sawed Hewed | | 202 | | | | 5.0 | 1909 | I.C. | Kankakee, Ill. | | |
| 3.2 | 6x8x8 | Sawed Hewed | Well Seasoned | 274 | | | | 5.0 | 1909 | " | Fulton, Ky. | | |
| 3.3 | 6x8x8 | Sawed Hewed | " | 274 | | | | 5.0 | 1910 | " | Greenville, Miss. | | |
| 3.4 | 6x8x8 | Sawed Hewed | | 248 | | | | | 1910 | " | Bloomington, Ill. | | |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 4.1 | | | | 5 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | BEECH— | (*Contin* | *ued* | ). | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 85-90 | Cin.,Gr.,Bt.C.,Rk | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.5 | Shoulder Flange | | " | 90 | Gravel | 10,586,000 | 1916 | 5. | 0 | | | 98.8% Good | | 1.2% Decayed. Includes gum | 4.11 |
| 1.6 | Wal-haupter | | " | 101 | Stone | | 1916 | 8. | 0 | | | | | Includes birch and maple | 44.10 |
| | | | | | CREOSOTE—(G | IUSSAN (See Oak | I). Ind | ex | No. 14 | .1). | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 3. | 0 | | | | | Includes birch and maple | 44.10 |
| 2.2 | " | | " | 101-91 | " | | 1916 | 4 & 5 | 0 | | | | | | 44.10 |
| 2.3 | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913 Placed, June, 1914. | 51.00 |
| 2.4 | " | 7 | " | 90 | " | 5,297,567 | 1916 | 2. | 0 | | | " | | | 51.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 3.1 | Sellers | 6x8 | Cut | 90 | Stone | | 1916 | 7. | 11.40 | | | | | Removed acct. derailment. 50% tie plated. Includes gum. | 12.11 |
| 3.2 | " | 6x8 | " | 90 | Gravel | | 1916 | 7. | 3.30 | | 3.30 | * | | Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 3.3 | " | 6x8 | " | 75 | Dirt, Gr., Since | | 1916 | 6. | 1.80 | | 1.80 | | | *Worn out and split, badly creeping track. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 3.4 | " | 6x8 | " | 75 | Gravel | | 1916 | 6. | 0 | | | | | 50% tie plated. Includes chestnut, elm and gum. | 12.11 |
| | | | | | CR | EOSOTE | AN | D C | RUD | E OI | L. | | | | |
| 4.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie plates under joints | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | CRE | OSOTE, | BEECH—(*Continued*). 80%; TAR, 20%—(LOWRY). | | | | | | |
| 5.1 | 6x8x8 | Sawed | Seasoned 6 mos. | 1,507 | Ill. | | 8.46 | 2.54 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 6.1 | | | | 6 | | | CRUDE OIL. | | 1911 | C.B.&Q. | Baders, Ill. | | |
| 7.1 | | | Seasoned | 48 | | | J. M. LONG'S | LIQUID. 0.287 | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | UNTREATED. | | | | | | |
| 8.1 | | | | 110 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 8.2 | | | | 23 | | | | | 1910 | " | " " | | |
| 8.3 | | | | 58 | | | | | 1909 | " | " West | | |
| 8.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 9.1 | | | | 106 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 9.2 | | | | 104 | | | | 0.50 | 1910 | " | " " | | |
| 9.3 | | | | 60 | | | | 0.50 | 1909 | " | " West | | |
| 9.4 | | | | 44 | | | | 0.50 | 1910 | " | " " | | |
| 9.5 | 6x8x8 | Sawed | Air-Seasoned | 500 | | 18 to Rl. | 1⅛ | 0.50 | 1911 | C.M.& St.P. | Minneiska, Minn. | " | 0 |
| 9.6 | 6x8x8 | Sawed | Seasoned 8 mos. | 28 | Ky. | | 1.417 | .511 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 9.7 | 6x8x8 | Hewed | Seasoned 8 mos. | 775 | " | | 1.417 | .511 | 1912 | " | " | | |
| 9.8 | 6x8x8 | Sawed Hewed | Seasoned | 274 | | | | 0.50 | 1909 | I.C. | Kankakee, Ill. | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CREOSOT | BEEC E, 80%; | H TA | —( R, | *Con* 20%— | *tinu* (LO | *ed*). WR | Y). | | | |
| 5.1 | | | | | | | 1916 | 4. | 0 | | | | | Ave. sapwood, 50% | 8.10 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 6.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie plates under joints | 5.20 |
| | | | | | | J. M. | LO | NG' | S LIQ | UID. | | | | | |
| 7.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 100.00 | 100.00 | | | 4½ | 50% tie plated | 12.11 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 8.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.40 | | | | | | 5.20 |
| 8.2 | " | | " | 90 | Gravel | | 1916 | 6. | 65.20 | | | | | | 5.20 |
| 8.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.60 | | | | | | 5.20 |
| 8.4 | " | | " | 75-85-90 | " | | 1916 | 6. | 26.70 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 9.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 11.30 | | | | | | 5.20 |
| 9.2 | All | | " | 90 | Cinders | | 1916 | 6. | 1.00 | | | | | | 5.20 |
| 9.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.70 | | | | | | 5.20 |
| 9.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 9.5 | None | | Cut | 90 | Gravel | Heavy | 1916 | 5. | 0.20 | 0.20 | | 94.4% Very Good | | Steamed before treatment. | 6.11 |
| 9.6 | | | | | | | 1916 | 4. | 0 | | | | | Treated ties stacked in open piles 26 days before setting. Ave. sapwood, 20%. | 8.10 |
| 9.7 | | | | | | | 1916 | 4. | 0 | | | | | Ave. sapwood, 20%. Treated ties stacked in open piles 26 days before setting. | 8.10 |
| 9.8 | Sellers | 6x8 | Cut | 90 | Stone | | 1916 | 7. | 24.10 | | | | | Removed acct. derailment. Includes ash, elm, gum, chestnut and maple. 50% tie plated. | 12.11 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | BEECH— | (*Continue* | *d*). | | | | |
| 9.9 | 6x8x8 | Sawed Hewed | " | 274 | ZINC | CHLOR | IDE—(BUR | NETT). 0.50 | 1910 | I.C. | Bloomington, Ill. | | |
| 9.10 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1909 | " | Fulton, Ky. | | |
| 9.11 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1910 | " | Greenville, Miss. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 10.1 | | | | 433 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 10.2 | | | | 370 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " " | | |
| 10.3 | | | | 37 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | " " | | |
| 10.4 | | | | 240 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 10.5 | | | | 177 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 10.6 | 7x9x8½ | Sawed Hewed | Peeled Seasoned | 1,107 | | | | Zn. 0.50 Cre. 2.00 | 1911 | B.&O. | Windsor, O. | | |
| 10.7 | 6x8x8 | Sawed | Seasoned 8 mos. | 162 | N. Wis | 19 to Rl. | 6.6 | Zn. 0.50 Cre. 2.00 | 1913 | C.M.& St. P. | Lake Wis. | Tang. | 0 |
| 10.8 | 6x8x8 | | | 125 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | | BIR | CH. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| | | | | | | (See | Birch Index | No. 1.6). | | | | | |

| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates | | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l | | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | Kind | Size In. | | | | | | | | Decay % | Wear % | | | | |
| | | | | | | BEEC | H | —( | *Con* | *tinu* | *ed*). | | | | |
| 9.9 | " | 6x8 | " | 75 | Gravel | | 1916 | 6. | 0 | | | | | Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 9.10 | " | 6x8 | " | 90 | " | | 1916 | 7. | 8.40 | | 8.40 | | | Includes ash, elm, gum, chestnut and maple. Worn out and split, badly creeping track. Badly checked and spikes worn. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 9.11 | " | 6x8 | " | 75 | Dirt Gravel since 1912 | | 1916 | 6. | 10.50 | | | | | Badly checked and spike worn. 50% tie-plated. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 10.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.50 | | | | | | 5.20 |
| 10.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 7. | 0 | | | | | | 5.20 |
| 10.3 | Yes | | " | 75 | " | | 1916 | 5. | 0 | | | | | | 5.20 |
| 10.4 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.90 | | | | | | | 5.20 |
| 10.5 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 10.6 | Shoulder Flanges | | " | 90 | Gravel | Heavy | 1916 | 5. | 0 | | | 99.2% good | | 0.8% Decayed. Includes gum. | 4.11 |
| 10.7 | None | | " | 85 | Cinder | Light | 1916 | 4. | 0 | | | good | | Sawed boxed heart. | 6.11 |
| 10.8 | | | | 90 | Slag | | 1916 | 8. | 2.40 | | | | | | 48.00 |
| | | | | | | | BI | RC | H. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| | | | | | (See Birch Index | No. 1.6). | | | | | | | | | |



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| " " | " | Tamarack | 224, 225 |


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## Cross-Tie Records—Service Tests.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | ASH. | | | | | | |
| | | | | | | CREOS | OTE—(FUL | L-CELL). | | | | | |
| 1.1 | | | | 19 | | | | 9.62 | 1910 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 1 | | | | 9.62 | 1909 | " | " West | | |
| 1.3 | | | | 15 | | | | 9.62 | 1910 | " | " " | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8 | Hewed | Seasoned | 44 | Minn. | 19 to Rl. | 22.8 | 6.50 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech, Index | Nos. 3.2-3.3 | .) | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 54 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 14 | | | | | 1910 | " | " " | | |
| 3.3 | | | | 30 | | | | | 1909 | " | " West | | |
| 3.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.1 | 0). | | | | |
| 4.1 | | | | 16 | | | | 0.50 | 1910 | C.B.&Q. | Lines East | | |
| 4.2 | | | Seasoned 1 year | 15 | | | | 0.50 | 1910 | " | " West | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 148 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 123 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 88 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 5.4 | | | | 15 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.5 | 6x8x8 | | | 325 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |

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| Index No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ASH—(*Continued*). | | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Burnt Clay & Cin. | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.2 | Yes | | " | 85 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.3 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | Flat | 6x8½ 9/16 | " | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | O. K. | | | 19.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | (See | Beech, I | ndex | Nos. | 3.2-3. | 3). | | | | | |
| | | | | | UNTREATED. | | | | | | | | | | |
| 3.1 | Yes | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 100.00 | | | | 4.6 | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6. | 71.40 | | | | | | 5.20 |
| 3.2 | Yes | | " | 75-85-90 | Cin., Gr., Rock | | 1915 | 6. | 100.00 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Burnt Clay | | 1916 | 6. | 60.00 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | (See Beech Index | Nos. 9.8- | 9.10 | ). | | | | | | | |
| 4.1 | All | | Cut | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.2 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 6.30 | | | | | | 5.20 |
| 5.2 | " | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.30 | | | | | | 5.20 |
| 5.4 | " | | " | 75-85-90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.5 | | | | 90 | Slag | | 1916 | 8. | 2.10 | | | | | | 48.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | BEECH. | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 206 | | | | 11.12 | 1909 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 99 | | | | 11.12 | 1910 | " | " " | | |
| 1.3 | | | | 119 | | | | 11.12 | 1909 | " | " West | | |
| 1.4 | | | | 44 | | | | 11.12 | 1910 | " | " " | | |
| 1.5 | 7x9x8½ | Hewed Sawed | Peeled Seasoned | 250 | | | Gal. 2.5 | Gal. 0.675 | 1911 | B.&O. | Windsor, O. | | |
| 1.6 | 7x9x8½ | | Steamed | 255 | | | | | 1908 | D.L.&W. | Boonton, N. J. | | |
| | | | | | | CR | EOSOTE—( | GIUSSANI | ). | | | | |
| | | | | | | ( | See Oak Index | No. 14.1.) | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8½ | | Seasoned | 812 | | | Gal. 5 | | 1913 | D.L.&W. | Paterson, N. J. | | |
| 2.2 | 7x9x8½ | | " | 158,000 | | | Gal. 3.5 | | 1910-11 | D.L.&W. | Cut-off | | |
| 2.3 | 6x8x8 | Sawed | " | 198 | Ind. | 20" | 18.7 | 7.0 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | .5 |
| 2.4 | 6x8x8 | Hewed | " | 198 | " | 20" | 30.1 | 11.3 | 1914 | " | " | " | .5 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 3.1 | 6x8x8 | Sawed Hewed | | 202 | | | | 5.0 | 1909 | I.C. | Kankakee, Ill. | | |
| 3.2 | 6x8x8 | Sawed Hewed | Well Seasoned | 274 | | | | 5.0 | 1909 | " | Fulton, Ky. | | |
| 3.3 | 6x8x8 | Sawed Hewed | " | 274 | | | | 5.0 | 1910 | " | Greenville, Miss. | | |
| 3.4 | 6x8x8 | Sawed Hewed | | 248 | | | | | 1910 | " | Bloomington, Ill. | | |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 4.1 | | | | 5 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates Kind | Tie Plates Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Re-moved % | Cause R'm'v'l Decay % | Cause R'm'v'l Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | BEECH—(*Continued*). | | | | | | | | | | |
| | | | | | CREOSOTE—(FULL-CELL). | | | | | | | | | | |
| 1.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 85-90 | Cin.,Gr.,Bt.C.,Rk | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.5 | Shoulder Flange | | " | 90 | Gravel | 10,586,000 | 1916 | 5. | 0 | | | 98.8% Good | | 1.2% Decayed. Includes gum | 4.11 |
| 1.6 | Wal-haupter | | " | 101 | Stone | | 1916 | 8. | 0 | | | | | Includes birch and maple | 44.10 |
| | | | | | CREOSOTE—(GIUSSANI). (See Oak Ind ex No. 14.1). | | | | | | | | | | |
| | | | | | CREOSOTE—(LOWRY). | | | | | | | | | | |
| 2.1 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 3. | 0 | | | | | Includes birch and maple | 44.10 |
| 2.2 | " | | " | 101-91 | " | | 1916 | 4 & 5 | 0 | | | | | | 44.10 |
| 2.3 | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913 Placed, June, 1914. | 51.00 |
| 2.4 | " | 7 | " | 90 | " | 5,297,567 | 1916 | 2. | 0 | | | " | | | 51.00 |
| | | | | | CREOSOTE—(REUPING). | | | | | | | | | | |
| 3.1 | Sellers | 6x8 | Cut | 90 | Stone | | 1916 | 7. | 11.40 | | | | | Removed acct. derailment. 50% tie plated. Includes gum. | 12.11 |
| 3.2 | " | 6x8 | " | 90 | Gravel | | 1916 | 7. | 3.30 | | 3.30 | | | Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 3.3 | " | 6x8 | " | 75 | Dirt, Gr., Since | | 1916 | 6. | 1.80 | | 1.80 | | | *Worn out and split, badly creeping track. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 3.4 | " | 6x8 | " | 75 | Gravel | | 1916 | 6. | 0 | | | | | 50% tie plated. Includes chestnut, elm and gum. | 12.11 |
| | | | | | CREOSOTE—(ANDERSON). | | | | | | | | | | |
| 4.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie plates under joints | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued).*

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | CRE | OSOTE, | BEECH—80%; TAR, | *(Continued).* 20%—(LOWRY). | | | | | |
| 5.1 | 6x8x8 | Sawed | Seasoned 6 mos. | 1,507 | Ill. | | 8.46 | 2.54 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 6.1 | | | | 6 | | | CRUDE OIL. | | 1911 | C.B.&Q. | Baders, Ill. | | |
| 7.1 | | | Seasoned | 48 | | | J. M. LONG'S | LIQUID. 0.287 | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | UNTREATED. | | | | | | |
| 8.1 | | | | 110 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 8.2 | | | | 23 | | | | | 1910 | " | " " | | |
| 8.3 | | | | 58 | | | | | 1909 | " | " West | | |
| 8.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 9.1 | | | | 106 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 9.2 | | | | 104 | | | | 0.50 | 1910 | " | " " | | |
| 9.3 | | | | 60 | | | | 0.50 | 1909 | " | " West | | |
| 9.4 | | | | 44 | | | | 0.50 | 1910 | " | " " | | |
| 9.5 | 6x8x8 | Sawed | Air-Seasoned | 500 | | 18 to Rl. | 1⅛ | 0.50 | 1911 | C.M.& St.P. | Minneiska, Minn. | " | 0 |
| 9.6 | 6x8x8 | Sawed | Seasoned 8 mos. | 28 | Ky. | | 1.417 | .511 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 9.7 | 6x8x8 | Hewed | Seasoned 8 mos. | 775 | " | | 1.417 | .511 | 1912 | " | " | | |
| 9.8 | 6x8x8 | Sawed Hewed | Seasoned | 274 | | | | 0.50 | 1909 | I.C. | Kankakee, Ill. | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CREOSOT | BEEC E, 80%; | H TA | —( R, | *Con* 20%— | *tinu* (LO | *ed*). WR | Y). | | | |
| 5.1 | | | | | | | 1916 | 4. | 0 | | | | | Ave. sapwood, 50% | 8.10 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 6.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie plates under joints | 5.20 |
| | | | | | | J. M. | LO | NG' | S LIQ | UID. | | | | | |
| 7.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 100.00 | 100.00 | | | 4½ | 50% tie plated | 12.11 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 8.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.40 | | | | | | 5.20 |
| 8.2 | " | | " | 90 | Gravel | | 1916 | 6. | 65.20 | | | | | | 5.20 |
| 8.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.60 | | | | | | 5.20 |
| 8.4 | " | | " | 75-85-90 | " | | 1916 | 6. | 26.70 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 9.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 11.30 | | | | | | 5.20 |
| 9.2 | All | | " | 90 | Cinders | | 1916 | 6. | 1.00 | | | | | | 5.20 |
| 9.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.70 | | | | | | 5.20 |
| 9.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 9.5 | None | | Cut | 90 | Gravel | Heavy | 1916 | 5. | 0.20 | 0.20 | | 94.4% Very Good | | Steamed before treatment. | 6.11 |
| 9.6 | | | | | | | 1916 | 4. | 0 | | | | | Treated ties stacked in open piles 26 days before setting. Ave. sapwood, 20%. | 8.10 |
| 9.7 | | | | | | | 1916 | 4. | 0 | | | | | Ave. sapwood, 20%. Treated ties stacked in open piles 26 days before setting. | 8.10 |
| 9.8 | Sellers | 6x8 | Cut | 90 | Stone | | 1916 | 7. | 24.10 | | | | | Removed acct. derailment. Includes ash, elm, gum, chestnut and maple. 50% tie plated. | 12.11 |



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## Cross-Tie Records—Service Tests—*(Continued).*

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | BEECH— | *(Continue* | *d).* | | | | |
| 9.9 | 6x8x8 | Sawed Hewed | " | 274 | ZINC | CHLOR | IDE—(BUR | NETT). 0.50 | 1910 | I.C. | Bloomington, Ill. | | |
| 9.10 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1909 | " | Fulton, Ky. | | |
| 9.11 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1910 | " | Greenville, Miss. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 10.1 | | | | 433 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 10.2 | | | | 370 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " " | | |
| 10.3 | | | | 37 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | " " | | |
| 10.4 | | | | 240 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 10.5 | | | | 177 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 10.6 | 7x9x8½ | Sawed Hewed | Peeled Seasoned | 1,107 | | | | Zn. 0.50 Cre. 2.00 | 1911 | B.&O. | Windsor, O. | | |
| 10.7 | 6x8x8 | Sawed | Seasoned 8 mos. | 162 | N. Wis | 19 to Rl. | 6.6 | Zn. 0.50 Cre. 2.00 | 1912 | C.M.& St. P. | Lake Wis. | Tang. | 0 |
| 10.8 | 6x8x8 | | | 125 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | | BIR | CH. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| | | | | | | (See | Birch Index | No. 1.6). | | | | | |

| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | BEEC | H | —( | *Con* | *tinu* | *ed*). | | | | |
| 9.9 | " | 6x8 | " | 75 | Gravel | | 1916 | 6. | 0 | | | | | Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 9.10 | " | 6x8 | " | 90 | " | | 1916 | 7. | 8.40 | | 8.40 | | | Includes ash, elm, gum, chestnut and maple. Worn out and split, badly creeping track. Badly checked and spikes worn. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| 9.11 | " | 6x8 | " | 75 | Dirt Gravel since 1912 | | 1916 | 6. | 10.50 | | | | | Badly checked and spike worn. 50% tie-plated. Includes ash, elm, gum, chestnut and maple. | 12.11 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 10.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.50 | | | | | | 5.20 |
| 10.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 7. | 0 | | | | | | 5.20 |
| 10.3 | Yes | | " | 75 | " | | 1916 | 5. | 0 | | | | | | 5.20 |
| 10.4 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.90 | | | | | | | 5.20 |
| 10.5 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 10.6 | Shoulder Flanges | | " | 90 | Gravel | Heavy | 1916 | 5. | 0 | | | 99.2% good | | 0.8% Decayed. Includes gum. | 4.11 |
| 10.7 | None | | " | 85 | Cinder | Light | 1916 | 4. | 0 | | | good | | Sawed boxed heart. | 6.11 |
| 10.8 | | | | 90 | Slag | | 1916 | 8. | 2.40 | | | | | | 48.00 |
| | | | | | | | BI | RC | H. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| | | | | | (See Birch Index | No. 1.6). | | | | | | | | | |



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## Cross-Tie Records—Service Tests—*(Continued).*

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | CR | BIRCH—EOSOTE—( | *(Continued* LOWRY.) | *ed).* | | | | |
| | | | | | | (See | Birch Index | No. 2.1). | | | | | |
| 1.1 | 7x9x8 | Hewed | Seasoned | 49 | Minn. | 19 to Rl. | 22.8 | 6.5 | 1908 | N.P. | Sumner, Wash. | Tang. | |
| | | | | | | | BIRCH—( | Red). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 2.1 | | | | 45 | | | | | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 2.2 | | | | 30 | | | | | 1910 | " | Blanding, Ill. | | |
| 2.3 | | | | 14 | | | | | 1911 | " | Baders, Ill. | | |
| 2.4 | | | | 59 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 49 | | | | | 1910 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 30 | | | | | 1910 | " | Lines West | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 4.1 | | | | 73 | | | | 0.5 | 1910 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 30 | | | | 0.5 | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 433 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 276 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 238 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 5.4 | | | | 122 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | BIRCH—(*Co* | *ntinued* | ). | | | | | | | | |
| | | | | | (See Birch Index | No. 2.1). | | | | | | | | | |
| | | | | | (S | ee Beech | Ind | ex | No. 2. | 1). | | | | | |
| 11.1 | Flat | 6x8½x 9/16 | Cut | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | | | | 19.00 |
| | | | | | | B | IR | CH | —(R | ed). | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 2.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 2.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 2.3 | Except under joints | | " | 75 | Gravel | | 1916 | 5. | 0 | | | | | | 5.20 5.20 |
| 2.4 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 91.90 | | | | | | 5.20 |
| 3.2 | Yes | | " | 90 | Lyons Stone | | 1915 | 5. | 100.00 | | | | 3.4 | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 4.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 2.70 | | | | | | 5.20 |
| 4.2 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 3.30 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 4.60 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0.40 | | | | | | 5.20 |
| 5.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| 6.1 | 6x8x8 | | | 288 | | BIRCH—ZINC CREOSOTE | | (Yellow).—(CARD). Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| 7.1 | 6x8x8 | | | 325 | | BIRCH—ZINC CREOSOTE | | (White).—(CARD). Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| 1.1 | 7x8x8½ | Hewed | Bored for S. Sp. | 122 | Ohio | 17 to 33' | CATAL UNTRE | PA. ATED. | 1907 | Penn. | Urbana, O. | Tang. | 0.7 down |
| 1.2 | 7x8x8½ | " | " " " | 495 | " | 16 to 33' | | | 1909 | " | St. Paris, O. | Tang. & 2° | 1.1 down |
| 1.1 | 7x8x8 | | | 965 | | (See Ta | CED AR—(Nor UNTRE marack Ind | thern Wh ATED. ex No. 6.9 | ite). ). 1904 | G.N. | Mohall, N. D. | Tang. | |
| 1.2 | 7x7x8 | Pole | | 500 | Mich. | 17 to Rl. | | | 1902 | C.M.& St.P. | Lynden, Wis. | " | 1.0 |
| 1.3 | 6x6x8 | Sawed faces | | 177 | " | 22 to Rl. | | | 1911 | " | Monroe, Wis. | " | 0 |
| 1.4 | 6x6x8 | Sawed faces | | 97 | " | 22 to Rl. | | | 1913 | " | " | " | 0 |
| 1.5 | 6x6x8 | Hewed | | 500 | " | 18 to Rl. | | | 1912 | " | Milwaukee, Wis. | " | 0 |
| 1.6 | 6x6x8 | " | | 500 | " | 18 to Rl. | | | 1912 | " | " | " | 0 |
| 1.7 | 6x7x8 | " | | 1,000 | " | 17 to Rl. | | | 1914 | " | Cranmoor, Wis. | " | 0 |
| 1.8 | 6x7x8 | " | | 1,000 | " | 17 to Rl. | | | 1914 | " | Merrill, Wis. | " | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | | BIRC | H | —( | Yello | v). | | | | | |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 6.1 | | | | 90 | Slag | | 1916 | 8. | 1.00 | | | | | | 48.00 |
| | | | | | | BIRC | H | —( | Whit | e). | | | | | |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 7.1 | | | | 90 | Slag | | 1916 | 8. | 0.90 | | | | | | 48.00 |
| | | | | | | CA | TA | LP | A. | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | Goldie | 7x9 | Screw | 85 | Gravel | 11,000,000 | 1916 | 9. | 34.00 | | | Poor | | Removed for decay and wear | 20.11 |
| 1.2 | Yes | 7x10 | " | 85 | " | 11,000,000 | 1916 | 7½ | 41.00 | | | " | | Removed for decay and wear | 20.11 |
| | | | | | CEDAR—( | Norther | n | Wh | ite). | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | None | | 9/16x 5½ | 68 | Gravel | 315,650 | 1916 | 12. | 59.20 | 59.20 | | | | | 40.10 |
| 1.2 | M. I. | 4½x7½ | Com. | 85 | " | Heavy | 1916 | 14. | 50.00 | | 50.00 | | | Removed because of rail-cut. O. & C. tie plates until 1912. | 6.11 |
| 1.3 | None | | " | 60 | Cinders | " | 1916 | 5. | 23.00 | | | Fair | | Removed because of de-rail—ties broken. | 6.11 |
| 1.4 | " | | " | 60 | " | " | 1916 | 3. | 0 | | | Good | | | 6.11 |
| 1.5 | Sellers | 5x8 | " | 65 | Gravel | " | 1916 | 4. | 0 | | | " | | | 6.11 |
| 1.6 | None | | " | 65 | " | Medium | 1916 | 4. | 0 | | | " | | Slightly rail-cut. | 6.11 |
| 1.7 | Sellers | 5x8 | | 85 | Sand | Heavy | 1916 | 2. | 0 | | | " | | Most of these rail-cut to ¼ inch. | 6.11 |
| 1.8 | None | | | 85 | Clay & Gravel | " | 1916 | 2. | 0 | | | " | | | 6.11 |



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| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | CEDA | R—Northe | rn White | ).—( | *Continu* | *ed).* | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.9 | | | | 1,000 | | | | | 1903 | C.&N.W. | Elmhurst, Ill. | | |
| 1.10 | 6x8x8 | Hewed | | 11,516 | | | | | 1900 | C.R.I.&P. | Sibley, Ia. | | |
| 1.11 | 6x8x8 | " | | 2,001 | | | | | 1898 | " | Vinton, Ia. | | |
| | | | | | | CED | AR—(Wes | tern Red | ). | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.1 | 7x7x8 | Pole | | 445 | Wash. | 18 to Rl. | | | 1913 | C.M.& St.P. | Jefferson, S. D. | Tang. | |
| | | | | | | | CHERR | Y. | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 6x8x8 | Hewed | Seasoned | 6 | Ind. | 20" | 19.4 | 7.3 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| | | | | | | | CHESTN | UT, | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | 7x9x8½ | | Steamed | 88 | | | | | 1907 | D.&L.W. | Boonton, N. J. | | |
| 1.2 | 7x9x8½ | | | 95 | | | | | 1907 | " | " | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8½ | | | 733 | | | Gals. 3.5 | | 1912 | D.&L.W. | Paterson, N. J. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See B | eech Index N | os. 3.2-3.4 | ). | | | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CEDAR—(N UNTREATED. | orthern | Wh | ite) | —(C | *onti* | *nued* | ). | | | |
| 1.9 | 50% Wal-haupter 50% none | 4x6 | | 100 | Stone | | 1916 | 13. | 62.00 | | | | | Rail is cutting into ties. Probably all will be removed next season. | 48.00 |
| 1.10 | None | | Cut | 60 | Dirt, Gr. & Cin. | Light | 1916 | 16. | 17.10 | | | | | | 36.00 |
| 1.11 | | $\frac{1}{2}$x5x7$\frac{1}{2}$ | " | 80 | Gravel | 4,745,000 | 1916 | 18. | 69.60 | | | | | | 36.00 |
| | | | | | | CERA | D | —( | Wes | ter | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | Sellers | 5x8 | Cut | 85 | Gravel | Heavy | 1916 | 3. | 0 | | | Excellent | | | 6.11 |
| | | | | | | | CH | ER | RY. | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913. | 51.00 |
| | | | | | | CH | ES | TN | UT. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Wal-haupter | | Cut | 101 | Stone | | 1916 | 9. | 0 | | | | | | 44.10 |
| 1.2 | " | | " | 101 | " | | 1916 | 9. | 0 | | | | | | 44.10 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 4. | 0 | | | | | | 44.10 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | (See | Beech In | dex | Nos. | 3.2-3.4 | ). | | | | | |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | CHE | STNUT— | *(Continue* | *d).* | | | | |
| | | | | | | FU | EL OIL—( | LOW-PRE | SSUR | E). | | | |
| 3.1 | | Hewed | Seasoned | 278 | | | Gals. 2.26 | 6.7 | 1910 | Picatinny Arsenal | Dover, N. J. | | |
| | | | | | | | | UNTRE | ATED. | | | | |
| 4.1 | | | | 165 | | | | | | | | | |
| 4.2 | | | | 90 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 4.3 | 7x9x8½ | | Seasoned | 16 | | | | | 1909 | " | Lines West | | |
| | | | | | | | | | 1912 | D.&L.W. | Paterson, N. J. | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.11 | ). | | | | |
| 5.1 | 6x8x8 | | Seasoned | 23 | | 22 to Rl. | | 0.5 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 6.1 | | | | 165 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 6.2 | | | | 89 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| | | | | | | | COTTON | WOOD. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 85 | | | | 9.96 | 1909 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 37 | | | | 9.96 | 1909 | " | Lines West | | |
| | | | | | CREO | SOTE | 20% REFIN | ED TAR— | (LOW | RY). | | | |
| 2.1 | 7x9x8 | Sawed | Seasoned | 261 | Mont. | 16 to 30' Rail | 30 | 8.6 | 1910 | N.P. | Rocky Mt. Div. Montana | Tang. | 0 |
| 2.2 | 7x9x8 | " | " | 554 | " | 16 to 30' Rail | 30 | 8.6 | 1910 | " | Washington | " | 0 |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CHESTNUT | —(*Con* | *tin* | *ued* | ). | | | | | | |
| | | | | | FUEL | OIL—(L | OW- | PR | ESSU | RE). | | | | | |
| 3.1 | Flat & Flange | | | | | | 1915 | 5. | 0 | | | | | | 22.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 43.00 | | | | | | 5.20 |
| 4.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 26.70 | | | | | | 5.20 |
| 4.3 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 4. | 0 | | | | | | 44.10 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | (S | ee Beech | Ind | ex | Nos. | 9.8-9. | 10). | | | | |
| 5.1 | M.I.Rib., Fl.Steel | 6x8 | 65% C. 35% S. | 90 | Gravel | Heavy | 1916 | 5. | 0 | | | 100% Good | | | 27.00 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 6.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 36.00 | | | | | | 5.20 |
| 6.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 28.10 | | | | | | 5.20 |
| | | | | | | CO | TT | ON | WO | OD. | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| | | | | | CREOSOTE | 20% REF | IN | ED | TAR | —(L | OW | RY). | | | |
| 2.1 | | | Cut | 72 | Dirt & Sand | Light | 1915 | 5. | 0 | | | O. K. | | | 19.00 |
| 2.2 | Flat | 6x8½x 9/16 | | 72 | " " | Heavy | 1915 | 5. | 0 | | | " | | | 19.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | COTT | ONWOOD | —(*Contin* | *ued*). | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 56 | | | | | 1909 | C.B.&Q. | Lines East | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 4.1 | | | | 286 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 160 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | " | Lines West | | |
| | | | | | | | CYPRE | SS. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 15 | | | | | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 1.2 | | | | 10 | | | | | 1910 | " | Blanding, Ill. | | |
| 1.3 | | | | 29 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | | CRUDE OIL. | | | | | | |
| 2.1 | | | | 3 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 114 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 3.3 | | | | 60 | | | | | 1909 | " | Lines West | | |
| 3.4 | | | | 29 | | | | | 1910 | " | " " | | |
| 3.5 | 7x8x9 | | | 500 | | | | | 1905 | G.H.& S.A. | Bay View & San Leon | | |
| 3.6 | 7x8x9 | | | 500 | | | | | 1905 | " | " | | |
| 3.7 | 7x9x8 | | | 2,290 | | | | | 1909 | " | " | | |
| 3.8 | 7x9x8 | | | 3,637 | | | | | 1909 | " | " | | |
| 3.9 | | Hewed | | 282 | | | | | 1895 | " | Watkins, C. O. | | |
| 3.10 | | " | | 568 | | | | | 1895 | " | " " " | | |
| 3.11 | | " | | 73 | | | | | 1895 | " | " " " | | |
| 3.12 | | Sawed | | 374 | | | | | 1895 | " | " " " | | |
| 3.13 | | " | | 654 | | | | | 1895 | " | " " " | | |
| 3.14 | 7x9x9 | | | 6,675 | | | | | 1910 | " | Lafayette and Scott | | |

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| Index No. | Service Conditions—(Continued). Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | COTTONWO | OD—( | Con | tin | ued). | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1915 | 6. | 100.00 | | | | 2.6 | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E--(C | ARD | ). | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.10 | | | | | | 5.20 |
| 4.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 1.20 | | | | | | 5.20 |
| | | | | | | | CY | PR | ESS. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 2.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie-plates under joints | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 50.00 | | | | | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6. | 32.00 | | | | | | 5.20 |
| 3.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 80.00 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 6.90 | | | | | | 5.20 |
| 3.5 | Glendon | | | | Gravel | | 1916 | 11. | 31.80 | | | | | 24.9% account wreck | 7.10 |
| 3.6 | None | | | | " | | 1916 | 11. | 41.00 | | | | | 31.6% " " | 7.10 |
| 3.7 | Clark | | Screw | 80 | " | | 1916 | 7. | 0 | | | | | 5% decayed | 7.10 |
| 3.8 | " | | " | 80 | " | | 1916 | 7. | 0 | | | | | 5% " | 7.10 |
| 3.9 | Yes | | | | Dirt | | 1916 | 21. | 93.30 | | | | | | 7.10 |
| 3.10 | None | | | | " | | 1916 | 21. | 99.60 | | | | | | 7.10 |
| 3.11 | " | | | | Earth | | 1916 | 21. | 94.50 | | | | | | 7.10 |
| 3.12 | Yes | | | | " | | 1916 | 21. | 100.00 | | | | 15.2 | | 7.10 |
| 3.13 | None | | | | " | | 1916 | 21. | 100.00 | | | | 15.2 | | 7.10 |
| 3.14 | Clark | | " | 80 | Gravel | | 1916 | 6.5 | 0 | | | Good | | | 7.10 |

## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | CYPRESS | —(*Continued*). | | | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 4.1 | | | | 15 | | | | 0.50 | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 4.2 | | | | 10 | | | | 0.50 | 1910 | " | Blanding, Ill. | | |
| 4.3 | | | | 30 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 394 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 24 | | | | Zn. 0.50<br>Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 208 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | " | Lines West | | |
| 5.4 | | | | 47 | | | | Zn. 0.50<br>Cre. 3.00 | 1910 | " | " " | | |
| | | | | | | | CYPRESS | —(Red). | | | | | |
| | | | | | | | UNTREATED. | | | | | | |
| 6.1 | | | | 274 | | | | | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | CYPRESS | —(Yellow). | | | | | |
| | | | | | | | UNTREATED. | | | | | | |
| 7.1 | | | | 274 | | | | | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | ELM. | | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 7x9x8 | Hewed | Seasoned | 53 | Minn. | 19 to Rl. | 22.8 | 6.50 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech, Index | Nos. 3.2-3.4 | ). | | | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CYPRESS— | (*Contin* | *ued* | ). | | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 4.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E—(C | ARD | ). | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.30 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0.50 | | | | | | 5.20 |
| 5.4 | " | | | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CYP | RE | SS | —(R | ed). | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 6.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 0 | | | | | 50% tie-plated | 12.11 |
| | | | | | | CYPRE | SS | —( | Yello | w). | | | | | |
| | | | | | | UN | TR | EAT | ED | | | | | | |
| 7.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 0.40 | 0.40 | | | | 50% " " | 12.11 |
| | | | | | | | EL | M. | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Flat | 6x8½x 9/16 | Cut | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | O. K. | | | 19.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | | (See Beec | h, | Inde | x Nos. | 3.2- | 3.4). | | | | |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | BIRCH— | (Yellow). | | | | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 6.1 | 6x8x8 | | | 288 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | | BIRCH— | (White). | | | | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 7.1 | 6x8x8 | | | 325 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | | CATAL | PA. | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.1 | 7x8x8½ | Hewed | Bored for S. Sp. | 122 | Ohio | 17 to 33' | | | 1907 | Penn. | Urbana, O. | Tang. | 0.7 down |
| 1.2 | 7x8x8½ | " | " " " | 495 | " | 16 to 33' | | | 1909 | " | St. Paris, O. | Tang. & 2° | 1.1 down |
| | | | | | | | CED | AR—(Nor | thern Wh | ite). | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| | | | | | | (See Ta | marack Ind | ex No. 6.9 | ). | | | | |
| 1.1 | 7x8x8 | | | 965 | | | | | 1904 | G.N. | Mohall, N. D. | Tang. | |
| 1.2 | 7x7x8 | Pole | | 500 | Mich. | 17 to Rl. | | | 1902 | C.M.& St.P. | Lynden, Wis. | " | 1.0 |
| 1.3 | 6x6x8 | Sawed faces | | 177 | " | 22 to Rl. | | | 1911 | " | Monroe, Wis. | " | 0 |
| 1.4 | 6x6x8 | Sawed faces | | 97 | " | 22 to Rl. | | | 1913 | " | " | " | 0 |
| 1.5 | 6x6x8 | Hewed | | 500 | " | 18 to Rl. | | | 1912 | " | Milwaukee, Wis. | " | 0 |
| 1.6 | 6x6x8 | " | | 500 | " | 18 to Rl. | | | 1912 | " | " | " | 0 |
| 1.7 | 6x7x8 | " | | 1,000 | " | 17 to Rl. | | | 1914 | " | Cranmoor, Wis. | " | 0 |
| 1.8 | 6x7x8 | " | | 1,000 | " | 17 to Rl. | | | 1914 | " | Merrill, Wis. | " | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | | BIRC | H | —( | Yello | w). | | | | | |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 6.1 | | | | 90 | Slag | | 1916 | 8. | 1.00 | | | | | | 48.00 |
| | | | | | | BIRC | H | —( | Whit | e). | | | | | |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 7.1 | | | | 90 | Slag | | 1916 | 8. | 0.90 | | | | | | 48.00 |
| | | | | | | CA | TA | LP | A. | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | Goldie | 7x9 | Screw | 85 | Gravel | 11,000,000 | 1916 | 9. | 34.00 | | | Poor | | Removed for decay and wear | 20.11 |
| 1.2 | Yes | 7x10 | " | 85 | " | 11,000,000 | 1916 | 7½ | 41.00 | | | " | | Removed for decay and wear | 20.11 |
| | | | | | CEDAR—( | Norther | n | Wh | ite). | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | None | | 9/16x 5½ | 68 | Gravel | 315,650 | 1916 | 12. | 59.20 | 59.20 | | | | | 40.10 |
| 1.2 | M. I. | 4½x7½ | Com. | 85 | " | Heavy | 1916 | 14. | 50.00 | | 50.00 | | | Removed because of rail-cut. Q. & C. tie plates until 1912. | 6.11 |
| 1.3 | None | | " | 60 | Cinders | " | 1916 | 5. | 23.00 | | | Fair | | Removed because of de-rail—ties broken. | 6.11 |
| 1.4 | " | | " | 60 | " | " | 1916 | 3. | 0 | | | Good | | | 6.11 |
| 1.5 | Sellers | 5x8 | " | 65 | Gravel | " | 1916 | 4. | 0 | | | " | | | 6.11 |
| 1.6 | None | | " | 65 | " | Medium | 1916 | 4. | 0 | | | " | | Slightly rail-cut. | 6.11 |
| 1.7 | Sellers | 5x8 | | 85 | Sand | Heavy | 1916 | 2. | 0 | | | " | | Most of these rail-cut to ¼ inch. | 6.11 |
| 1.8 | None | | | 85 | Clay & Gravel | " | 1916 | 2. | 0 | | | " | | | 6.11 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | CEDA | R—Northe | rn White | ).—( | *Continu* | *ed*). | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.9 | | | | 1,000 | | | | | 1903 | C.&N.W. | Elmhurst, Ill. | | |
| 1.10 | 6x8x8 | Hewed | | 11,516 | | | | | 1900 | C.R.I.&P. | Sibley, Ia. | | |
| 1.11 | 6x8x8 | " | | 2,001 | | | | | 1898 | " | Vinton, Ia. | | |
| | | | | | | CED | AR—(Wes | tern Red | ). | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.1 | 7x7x8 | Pole | | 445 | Wash. | 18 to Rl. | | | 1913 | C.M.& St.P. | Jefferson, S. D. | Tang. | |
| | | | | | | | CHERR | Y. | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 6x8x8 | Hewed | Seasoned | 6 | Ind. | 20" | 19.4 | 7.3 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| | | | | | | | CHESTN | UT, | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | 7x9x8½ | | Steamed | 88 | | | | | 1907 | D.&L.W. | Boonton, N. J. | | |
| 1.2 | 7x9x8½ | | | 95 | | | | | 1907 | " | " | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 2.1 | 7x9x8½ | | | 733 | | | Gals. 3.5 | | 1912 | D.&L.W. | Paterson, N. J. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See B | eech Index N | os. 3.2-3.4 | ). | | | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CEDAR—(Northern White)—(Continued). UNTREATED. | | | | | | | | | | |
| 1.9 | 50% Walhaupter 50% none | 4x6 | | 100 | Stone | | 1916 | 13. | 62.00 | | | | | Rail is cutting into ties. Probably all will be removed next season. | 48.00 |
| 1.10 | None | | Cut | 60 | Dirt, Gr. & Cin. | Light | 1916 | 16. | 17.10 | | | | | | 36.00 |
| 1.11 | | $\frac{1}{2}$x5x7$\frac{1}{2}$ | " | 80 | Gravel | 4,745,000 | 1916 | 18. | 69.60 | | | | | | 36.00 |
| | | | | | | CERA | D | —( | Wes | tei | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | Sellers | 5x8 | Cut | 85 | Gravel | Heavy | 1916 | 3. | 0 | | | Excellent | | | 6.11 |
| | | | | | | | CH | ER | RY. | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913. | 51.00 |
| | | | | | | | CH | ES | TN | UT. | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Walhaupter | | Cut | 101 | Stone | | 1916 | 9. | 0 | | | | | | 44.10 |
| 1.2 | " | | " | 101 | " | | 1916 | 9. | 0 | | | | | | 44.10 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 4. | 0 | | | | | | 44.10 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | (See | Beech In | dex | Nos. | 3.2-3.4 | ). | | | | | |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | CHE | STNUT— | *(Continue* | *d).* | | | | |
| | | | | | | FU | EL OIL—( | LOW-PRE | SSUR | E). | | | |
| 3.1 | | Hewed | Seasoned | 278 | | | Gals. 2.26 | 6.7 | 1910 | Picatinny Arsenal | Dover, N. J. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 4.1 | | | | 165 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 90 | | | | | 1909 | " | Lines West | | |
| 4.3 | 7x9x8½ | | Seasoned | 16 | | | | | 1912 | D.&L.W. | Paterson, N. J. | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.11 | ). | | | | |
| 5.1 | 6x8x8 | | Seasoned | 23 | | 22 to Rl. | | 0.5 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 6.1 | | | | 165 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 6.2 | | | | 89 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| | | | | | | | COTTON | WOOD. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 85 | | | | 9.96 | 1909 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 37 | | | | 9.96 | 1909 | " | Lines West | | |
| | | | | | CREO | SOTE | 20% REFIN | ED TAR— | (LOW | RY). | | | |
| 2.1 | 7x9x8 | Sawed | Seasoned | 261 | Mont. | 16 to 30' Rail | 30 | 8.6 | 1910 | N.P. | Rocky Mt. Div. Montana | Tang. | 0 |
| 2.2 | 7x9x8 | " | " | 554 | " | 16 to 30' Rail | 30 | 8.6 | 1910 | " | Washington | " | 0 |

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| Service Conditions—(*Continued*). | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CHESTNUT | —(*Con* | *tin* | *ued* | ). | | | | | | |
| | | | | | FUEL | OIL—(L | OW- | PR | ESSU | RE). | | | | | |
| 3.1 | Flat & Flange | | | | | | 1915 | 5. | 0 | | | | | | 22.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 43.00 | | | | | | 5.20 |
| 4.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 26.70 | | | | | | 5.20 |
| 4.3 | D.L.&W. | | Screw | 101 | Stone | | 1916 | 4. | 0 | | | | | | 44.10 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | (S | ee Beech | Ind | ex | Nos. | 9.8-9. | 10). | | | | |
| 5.1 | M.I.Rib., Fl.Steel | 6x8 | 65% C. 35% S. | 90 | Gravel | Heavy | 1916 | 5. | 0 | | | 100% Good | | | 27.00 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 6.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 36.00 | | | | | | 5.20 |
| 6.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 28.10 | | | | | | 5.20 |
| | | | | | | CO | TT | ON | WO | OD. | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 1.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| | | | | | CREOSOTE | 20% REF | IN | ED | TAR | —(L | OW | RY). | | | |
| 2.1 | | | Cut | 72 | Dirt & Sand | Light | 1915 | 5. | 0 | | | O. K. | | | 19.00 |
| 2.2 | Flat | 6x8½x 9/16 | | 72 | " " | Heavy | 1915 | 5. | 0 | | | " | | | 19.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | COTT | ONWOOD | —(*Contin* | *ued*). | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 56 | | | | | 1909 | C.B.&Q. | Lines East | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 4.1 | | | | 286 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 160 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| | | | | | | | CYPRE | SS. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 15 | | | | | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 1.2 | | | | 10 | | | | | 1910 | " | Blanding, Ill. | | |
| 1.3 | | | | 29 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | | CRUDE OIL. | | | | | | |
| 2.1 | | | | 3 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 114 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 3.3 | | | | 60 | | | | | 1909 | " | Lines West | | |
| 3.4 | | | | 29 | | | | | 1910 | " | " " | | |
| 3.5 | 7x8x9 | | | 500 | | | | | 1905 | G.H.& S.A. | Bay View & San Leon | | |
| 3.6 | 7x8x9 | | | 500 | | | | | 1905 | " | " | | |
| 3.7 | 7x9x8 | | | 2,290 | | | | | 1909 | " | " | | |
| 3.8 | 7x9x8 | | | 3,637 | | | | | 1909 | " | " | | |
| 3.9 | | Hewed | | 282 | | | | | 1895 | " | Watkins, C. O. | | |
| 3.10 | | " | | 568 | | | | | 1895 | " | " " " | | |
| 3.11 | | " | | 73 | | | | | 1895 | " | " " " | | |
| 3.12 | | Sawed | | 374 | | | | | 1895 | " | " " " | | |
| 3.13 | | " | | 654 | | | | | 1895 | " | " " " | | |
| 3.14 | 7x9x9 | | | 6,675 | | | | | 1910 | " | Lafayette and Scott | | |

| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—(Continued). | | RESULTS. | | | | | | | | |
| | | | | | COTTONWO | OD—( | Con | tin | ued). | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1915 | 6. | 100.00 | | | | 2.6 | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E--(C | ARD | ). | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.10 | | | | | | 5.20 |
| 4.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 1.20 | | | | | | 5.20 |
| | | | | | | | CY | PR | ESS. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 2.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie-plates under joints | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 50.00 | | | | | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6. | 33.00 | | | | | | 5.20 |
| 3.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 80.00 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 6.90 | | | | | | 5.20 |
| 3.5 | Glendon | | | | Gravel | | 1916 | 11. | 31.80 | | | | | 24.9% account wreck | 7.10 |
| 3.6 | None | | | | " | | 1916 | 11. | 41.00 | | | | | 31.6% " " | 7.10 |
| 3.7 | Clark | | Screw | 80 | " | | 1916 | 7. | 0 | | | | | 5% decayed | 7.10 |
| 3.8 | " | | " | 80 | " | | 1916 | 7. | 0 | | | | | 5% " | 7.10 |
| 3.9 | Yes | | | | Dirt | | 1916 | 21. | 93.30 | | | | | | 7.10 |
| 3.10 | None | | | | " | | 1916 | 21. | 99.60 | | | | | | 7.10 |
| 3.11 | " | | | | Earth | | 1916 | 21. | 94.50 | | | | | | 7.10 |
| 3.12 | Yes | | | | " | | 1916 | 21. | 100.00 | | | | 15.2 | | 7.10 |
| 3.13 | None | | | | " | | 1916 | 21. | 100.00 | | | | 15.2 | | 7.10 |
| 3.14 | Clark | | " | 80 | Gravel | | 1916 | 6.5 | 0 | | | Good | | | 7.10 |

Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | CYPRESS | —(*Continued*). | | | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 4.1 | | | | 15 | | | | 0.50 | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 4.2 | | | | 10 | | | | 0.50 | 1910 | " | Blanding, Ill. | | |
| 4.3 | | | | 30 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 394 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 24 | | | | Zn. 0.50<br>Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 208 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | " | Lines West | | |
| 5.4 | | | | 47 | | | | Zn. 0.50<br>Cre. 3.00 | 1910 | " | " " | | |
| | | | | | | | CYPRESS | —(Red). | | | | | |
| | | | | | | | UNTREATED. | | | | | | |
| 6.1 | | | | 274 | | | | | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | CYPRESS | —(Yellow). | | | | | |
| | | | | | | | UNTREATED. | | | | | | |
| 7.1 | | | | 274 | | | | | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | ELM. | | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 7x9x8 | Hewed | Seasoned | 53 | Minn. | 19 to Rl. | 22.8 | 6.50 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech, Index | Nos. 3.2-3.4 | ). | | | | |

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| Index No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | CYPRESS— | (*Contin | *ued* | ). | | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 4.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E—(C | ARD | ). | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.30 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0.50 | | | | | | 5.20 |
| 5.4 | " | | | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CYP | RE | SS | —(R | ed). | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 6.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 0 | | | | | 50% tie-plated | 12.11 |
| | | | | | | CYPRE | SS | —( | Yello | w). | | | | | |
| | | | | | | UN | TR | EAT | ED | | | | | | |
| 7.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 0.40 | 0.40 | | | | 50% " " | 12.11 |
| | | | | | | | EL | M. | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Flat | 6x8½x 9/16 | Cut | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | O. K. | | | 19.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | | (See Beec | h, | Inde | x Nos. | 3.2- | 3.4). | | | | |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | ZINC | ELM—(*Continued*). CHLORIDE—(BURNETT). | | | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.11 | ). | | | | |
| | | | | | | CREO | ELM—(Hickory). SOTE AND TAR—(LOWRY). | | | | | | |
| 2.1 | 6x8x8 | Sawed | Seasoned 10 mos. | 68 | Ark. | | Gal. 2.55 | 7.57 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 2.2 | 6x8x8 | Hewed | Seasoned 10 mos. | 1,288 | " | | Gal. 2.55 | 7.57 | 1912 | " | " | | |
| | | | | | | CR | ELM—(White). EOSOTE—(FULL-CEL). | | | | | | |
| 3.1 | | | | 106 | | | | 12.97 | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 99 | | | | 12.97 | 1909 | " | " " | | |
| 3.3 | | | | 58 | | | | 12.97 | 1909 | " | Lines West | | |
| 3.4 | | | | 60 | | | | 12.97 | 1910 | " | " " | | |
| | | | | | | CR | EOSOTE—(LOWRY.) | | | | | | |
| | 6x8x8 | Hewed Sawed | Seasoned | 200 | Ind. | 20" | 23.3 | 8.7 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| | | | | | | | CRUDE OIL. | | | | | | |
| 4.1 | | | | 2 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | UNTREATED. | | | | | | |
| 5.1 | | | | 89 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 5.3 | | | | 48 | | | | | 1909 | " | Lines West | | |
| 5.4 | | | | 30 | | | | | 1910 | " | " " | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Ser-vice | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-erence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ELM | —( | *Con* | *tinue* | *d*). | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | | (See Beec | h | Inde | x Nos. | 9.8- | 9.11 | ). | | | |
| | | | | | | ELM | —( | Hic | kory | ). | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | | | | | | | 1916 | 4. | 0 | | | | | 20% tar and 80% creosote. Ave. sapwood, 60%. | 8.10 |
| 2.2 | | | | | | | 1916 | 4. | 0 | | | | | 20% tar and 80% creosote. Ave. sapwood, 60%. | 8.10 |
| | | | | | | EL | M | —( | Whit | e). | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.80 | | | | | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 7. | 4.00 | | | | | | 5.20 |
| 3.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913, placed June, 1914. | 51.00 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 4.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie-plates under joints. | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 93.20 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 6. | 76.00 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 100.00 | | | | 5.1 | All out in 7 years. | 5.20 |
| 5.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 43.30 | | | | | | 5.20 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | EL | M(—White | )—(*Conti* | *nued* | ). | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 6.1 | | | | 77 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 6.2 | | | | 146 | | | | 0.50 | 1910 | " | " " | | |
| 6.3 | | | | 43 | | | | 0.50 | 1909 | " | Lines West | | |
| 6.4 | | | | 30 | | | | 0.50 | 1910 | " | " " | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 7.1 | | | | 444 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 7.2 | | | | 195 | | | | Zn. 0.50 Cre. 3.00 | 1908 | " | " " | | |
| 7.3 | | | | 149 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 7.4 | | | | 165 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Chicago, Ill. | | |
| 7.5 | | | | 244 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 7.6 | | | | 121 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 7.7 | 6x8x8 | | | 76 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | FI | R—(DOUG | LAS—CO | AST | ). | | | |
| | | | | | | | CARBOL | INEUM. | | | | | |
| 1.1 | 7x9x8 | Sawed | Sun dried 90 days | 300 | Oregon or Wn. | 18 to Rl. | | 1.2 | 1908 | O.W.R. &N.C. | Dodson, Ore. | Tang. | |
| | | | | | | | CREO | SOTE. | | | | | |
| 2.1 | | Hewed | | 2,938 | Coast | | | 12.0 | 1911 | G.N. | Butte Div. | Tang. 70% Curve 30% | |
| 2.2 | | Sawed | | 3,453 | " | | | 12.0 | 1911 | " | Butte, Div. | Tang. 70% Curve 30% | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | EL M—(W | hit | e) | —(C | onti | nue | d). | | | |
| | | | | | ZINC CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 6.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 5.20 | | | | | | 5.20 |
| 6.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 6. | 1.40 | | | | | | 5.20 |
| 6.3 | Yes | | " | 75-85-90 | Cin.,Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 6.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZI NC CRE | OS | OT | E—(C | ARD | ). | | | | | |
| 7.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.40 | | | | | | 5.20 |
| 7.2 | " | | " | 90 | Gravel | | 1916 | 8. | 1.00 | | | | | Tie-plates on curves. | 5.20 |
| 7.3 | All | | " | 90 | " | | 1916 | 6. | 0.70 | | | | | | 5.20 |
| 7.4 | None | | " | 66 | Piling Driven in Sand | | 1916 | 6. | 0 | | | Fine | | | 5.20 |
| 7.5 | Yes | | " | 75-85-90 | Cin., Gr., Cl. St | | 1916 | 7. | 2.00 | | | | | | 5.20 |
| 7.6 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 7.7 | None | | " | 90 | Slag | | 1916 | 8. | 0 | | | | | Mechanical wear ¼ to 1 in. | 48.00 |
| | | | | | FIR —(DO | UG | LA | S—C | OA | ST | ). | | | | |
| | | | | | CARBOLI NEUM. | | | | | | | | | | |
| 1.1 | | 8x8½ | Cut | 75 | Gravel | 6,000,000 | 1916 | 8 | 1.70 | 1.70 | | Good | | | 28.00 |
| | | | | | CREOSOTE. | | | | | | | | | | |
| 2.1 | Goldie G. 58 | 6x8½ | ¾x6 | G. N. 90 | Gravel Av. 10" | | 1916 | 5½ | 59.00 | | | V. Poor | | Removed acct. check and split. Ties are crushing and checking. | 40.10 |
| 2.2 | J. G. 58 " | 6½x8½ 6½x8½ | ¾x6 | G. N. 90 | " | | 1916 | 5½ | 27.00 | | | " | | Removed acct. check and split. Ties are crushing and checking. | 40.10 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | FI | R—( | DOU | GLAS—C | OAST)— | (*Cont* | *inued*). | | | |
| | | | | | | | CREOSOTE. | | | | | | |
| 2.3 | | Sawed | | 1,000 | Oregon or Wash. | 18 to Rl. | | 8.0 | 1908 | O.W.R. &N.C. | Dodson, Ore. | 1% Curve partly on Tangent .35% grade | |
| | | | | | | CR | EOSOTE—( | BOILING) | | | | | |
| 3.1 | | | | 527 | Coast | | | | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 4.1 | 7x9x8 | Sawed | Seasoned | 173 | " | | | 6.2 | 1906 | N.P. | Maywood, Wash. | | |
| 4.2 | 7x9x8 | " | " | 46 | " | | | 6.2 | 1906 | " | " " | | |
| 4.3 | 7x9x8 | " | " | 100 | " | | | 6.2 | 1906 | " | " " | | |
| 4.4 | 7x9x8 | " | " | 71 | " | | | 6.2 | 1906 | " | " " | | |
| 4.5 | 7x9x8 | " | " | 52 | " | | | 6.2 | 1906 | " | " " | | |
| | | | | | | CR | EOSOTE—( | RUEPING). | | | | | |
| 5.1 | | | | 519 | " | | | 12.0 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 6.1 | | | | 156 | " | | | 12.0 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 7.1 | 7x8x8 | Sawed | Seasoned | 137 | Wash Coast | | | | 1911 | C.M.& St.P. | McGregor Ia. | | |

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| Service Conditions—*(Continued)*. | | | | | | | | Results. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | FIR—(DOU | GLAS | —C | OA | ST) | —(*C* | *onti* | *nued*). | | | |
| | | | | | CREOSOTE. | | | | | | | | | | |
| 2.3 | | 8x8¼ | Cut | C. S. Sect. 75 | Gravel replaced with crushed rock Jan. 1914 | 6,000,000 | 1916 | 8. | 0.20 | | | Good | | Gravel ballast replaced with crushed rock in Jan., 1914. | 28.00 |
| | | | | | | CREOSO | TE | —(B | OILI | NG). | | | | | |
| 3.1 | | | | | | | 1915 | 4. | 0 | | | | | Usual softening and cutting. | 19.00 |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 4.1 | Sellers | 6 3/16x8¼ | Cut | 85 | Gravel | Heavy | 1916 | 10. | 23.00 | | 23.00 | Fair | | Practically all ties not removed were turned in 1916 relaid with 90 lb. steel N. P. standard tie-plates and cut spikes. | 25.00 |
| 4.2 | " | 6 3/16x8¼ | Cut & Screw | 85 | " | " | 1916 | 10. | 20.00 | | 20.00 | " | | | 25.00 |
| 4.3 | " | 6 3/16x8¼ | Screw | 85 | " | " | 1916 | 10. | 9.00 | | 9.00 | " | | | 25.00 |
| 4.4 | None | | Cut | 85 | " | " | 1916 | 10. | 7.00 | | 7.00 | " | | | 25.00 |
| 4.5 | Sellers | 6 3/16x8¼ | " | 85 | " | " | 1916 | 10. | 0 | | | " | | | 25.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 5.1 | | | | | | | 1915 | 4. | 0 | | | | | Usual softening and cutting. | 19.00 |
| | | | | | CR | EOSOTE | AN | D C | RUD | E OI | L. | | | | |
| 6.1 | | | | | | | 1915 | 4. | 0 | | | | | 80% crude oil, 20% creosote. Usual softening and cutting. | 19.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 7.1 | None | | Cut | 65 | Cinder | Average | 1916 | 5. | 0 | | | Fair | | 94.9% good; 5.1% decayed | 6.11 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | COTT | ONWOOD | —(*Contin* | *ued*). | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 56 | | | | | 1909 | C.B.&Q. | Lines East | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 4.1 | | | | 286 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 160 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| | | | | | | | CYPRE | SS. | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 15 | | | | | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 1.2 | | | | 10 | | | | | 1910 | " | Blanding, Ill. | | |
| 1.3 | | | | 29 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | | CRUDE OIL. | | | | | | |
| 2.1 | | | | 3 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 114 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 25 | | | | | 1910 | " | " | | |
| 3.3 | | | | 60 | | | | | 1909 | " | Lines West | | |
| 3.4 | | | | 29 | | | | | 1910 | " | " | | |
| 3.5 | 7x8x9 | | | 500 | | | | | 1905 | G.H.& S.A. | Bay View & San Leon | | |
| 3.6 | 7x8x9 | | | 500 | | | | | 1905 | " | " | | |
| 3.7 | 7x9x8 | | | 2,290 | | | | | 1909 | " | " | | |
| 3.8 | 7x9x8 | | | 3,637 | | | | | 1909 | " | " | | |
| 3.9 | | Hewed | | 282 | | | | | 1895 | " | Watkins, C. O. | | |
| 3.10 | | " | | 568 | | | | | 1895 | " | " " " | | |
| 3.11 | | " | | 73 | | | | | 1895 | " | " " " | | |
| 3.12 | | Sawed | | 374 | | | | | 1895 | " | " " " | | |
| 3.13 | | " | | 654 | | | | | 1895 | " | " " " | | |
| 3.14 | 7x9x9 | | | 6,675 | | | | | 1910 | " | Lafayette and Scott | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—(Continued). | | RESULTS. | | | | | | | | |
| | | | | | COTTONWO | OD—( | Con | tin | ued). | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1915 | 6. | 100.00 | | | | 2.6 | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E--(C | ARD | ). | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.10 | | | | | | 5.20 |
| 4.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 1.20 | | | | | | 5.20 |
| | | | | | | | CY | PR | ESS. | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 2.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie-plates under joints | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 50.00 | | | | | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6. | 32.00 | | | | | | 5.20 |
| 3.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 80.00 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 6.90 | | | | | | 5.20 |
| 3.5 | Glendon | | | | Gravel | | 1916 | 11. | 31.80 | | | | | 24.9% account wreck | 7.10 |
| 3.6 | None | | | | " | | 1916 | 11. | 41.00 | | | | | 31.6% " " | 7.10 |
| 3.7 | Clark | | Screw | 80 | " | | 1916 | 7. | 0 | | | | | 5% decayed | 7.10 |
| 3.8 | " | | " | 80 | " | | 1916 | 7. | 0 | | | | | 5% " | 7.10 |
| 3.9 | Yes | | | | Dirt | | 1916 | 21. | 93.30 | | | | | | 7.10 |
| 3.10 | None | | | | " | | 1916 | 21. | 99.60 | | | | | | 7.10 |
| 3.11 | " | | | | Earth | | 1916 | 21. | 94.50 | | | | | | 7.10 |
| 3.12 | Yes | | | | " | | 1916 | 21. | 100.00 | | | | 15.2 | | 7.10 |
| 3.13 | None | | | | " | | 1916 | 21. | 100.00 | | | | 15.2 | | 7.10 |
| 3.14 | Clark | | " | 80 | Gravel | | 1916 | 6.5 | 0 | | | Good | | | 7.10 |

## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | CYPRESS | —(*Continued*). | | | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 4.1 | | | | 15 | | | | 0.50 | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 4.2 | | | | 10 | | | | 0.50 | 1910 | " | Blanding, Ill. | | |
| 4.3 | | | | 30 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 394 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 24 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 208 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 5.4 | | | | 47 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| | | | | | | | CYPRESS | —(Red). | | | | | |
| | | | | | | | UNTREATED. | | | | | | |
| 6.1 | | | | 274 | | | | | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | CYPRESS | —(Yellow). | | | | | |
| | | | | | | | UNTREATED. | | | | | | |
| 7.1 | | | | 274 | | | | | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | ELM. | | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 7x9x8 | Hewed | Seasoned | 53 | Minn. | 19 to Rl. | 22.8 | 6.50 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech, Index | Nos. 3.2-3.4 | ). | | | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | CYPRESS— | (*Contin* | *ued* | ). | | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 4.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.2 | " | | " | 90 | " " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 4.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E—(C | ARD | ). | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.30 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | " | | 1916 | 6. | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0.50 | | | | | | 5.20 |
| 5.4 | " | | | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CYP | RE | SS | —(R | ed). | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 6.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 0 | | | | | 50% tie-plated | 12.11 |
| | | | | | | CYPRE | SS | —( | Yello | w). | | | | | |
| | | | | | | UN | TR | EAT | ED | | | | | | |
| 7.1 | Economy | | | 75 | Dirt | | 1916 | 6. | 0.40 | 0.40 | | | | 50% " " | 12.11 |
| | | | | | | | EL | M. | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Flat | 6x8½x 9/16 | Cut | 85 | Gravel | Heavy | 1915 | 7. | 0 | | | O. K. | | | 19.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | | (See Beec | h, | Inde | x Nos. | 3.2- | 3.4). | | | | |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | ELM—(*Continued*). | | | | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.11 | ). | | | | |
| | | | | | | | ELM—( | Hickory). | | | | | |
| | | | | | | CREO | SOTE AND | TAR—(LOWRY). | | | | | |
| 2.1 | 6x8x8 | Sawed | Seasoned 10 mos. | 68 | Ark. | | Gal. 2.55 | 7.57 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 2.2 | 6x8x8 | Hewed | Seasoned 10 mos. | 1,288 | " | | Gal. 2.55 | 7.57 | 1912 | " | " | | |
| | | | | | | | ELM—( | White). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 3.1 | | | | 106 | | | | 12.97 | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 99 | | | | 12.97 | 1909 | " | " " | | |
| 3.3 | | | | 58 | | | | 12.97 | 1909 | " | Lines West | | |
| 3.4 | | | | 60 | | | | 12.97 | 1910 | " | " " | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| | 6x8x8 | Hewed Sawed | Seasoned | 200 | Ind. | 20" | 23.3 | 8.7 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| | | | | | | | CRUDE OIL. | | | | | | |
| 4.1 | | | | 2 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 5.1 | | | | 89 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 5.3 | | | | 48 | | | | | 1909 | " | Lines West | | |
| 5.4 | | | | 30 | | | | | 1910 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | | ELM | —( | *Con* | *tinue* | *d*). | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | | (See Beec | h | Inde | x Nos. | 9.8- | 9.11 | ). | | | |
| | | | | | | ELM | —( | Hic | kory | ). | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 2.1 | | | | | | | 1916 | 4. | 0 | | | | | 20% tar and 80% creosote. Ave. sapwood, 60%. | 8.10 |
| 2.2 | | | | | | | 1916 | 4. | 0 | | | | | 20% tar and 80% creosote. Ave. sapwood, 60%. | 8.10 |
| | | | | | | EL | M | —( | Whit | e). | | | | | |
| | | | | | CR | EOSOTE | | —( | FUL | L-CE | LL). | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.80 | | | | | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 7. | 4.00 | | | | | | 5.20 |
| 3.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2. | 0 | | | Excellent | | Treated July, 1913, placed June, 1914. | 51.00 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 4.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5. | 0 | | | | | No tie-plates under joints. | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 93.20 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 6. | 76.00 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 100.00 | | | | 5.1 | All out in 7 years. | 5.20 |
| 5.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 43.30 | | | | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | EL | M(—White | )—(*Conti* | *nued* | ). | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 6.1 | | | | 77 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 6.2 | | | | 146 | | | | 0.50 | 1910 | " | " " | | |
| 6.3 | | | | 43 | | | | 0.50 | 1909 | " | Lines West | | |
| 6.4 | | | | 30 | | | | 0.50 | 1910 | " | " " | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 7.1 | | | | 444 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 7.2 | | | | 195 | | | | Zn. 0.50 Cre. 3.00 | 1908 | " | " " | | |
| 7.3 | | | | 149 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 7.4 | | | | 165 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Chicago, Ill. | | |
| 7.5 | | | | 244 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 7.6 | | | | 121 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 7.7 | 6x8x8 | | | 76 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | FI | R—(DOUG | LAS—CO | AST | ). | | | |
| | | | | | | | CARBOL | INEUM. | | | | | |
| 1.1 | 7x9x8 | Sawed | Sun dried 90 days | 300 | Oregon or Wn. | 18 to Rl. | | 1.2 | 1908 | O.W.R. &N.C. | Dodson, Ore. | Tang. | |
| | | | | | | | CREO | SOTE. | | | | | |
| 2.1 | | Hewed | | 2,938 | Coast | | | 12.0 | 1911 | G.N. | Butte Div. | Tang. 70% Curve 30% | |
| 2.2 | | Sawed | | 3,453 | " | | | 12.0 | 1911 | " | Butte, Div. | Tang. 70% Curve 30% | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | EL | M—(W | hit | e) | —(C | onti | nue | d). | | | |
| | | | | | ZINC | CHLORI | DE. | —( | BURN | ETT | ). | | | | |
| 6.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 5.20 | | | | | | 5.20 |
| 6.2 | All | | " | 90 | Sheridan Gravel | | 1916 | 6. | 1.40 | | | | | | 5.20 |
| 6.3 | Yes | | " | 75-85-90 | Cin.,Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 6.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | ZI | NC CRE | OS | OT | E—(C | ARD | ). | | | | |
| 7.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.40 | | | | | | 5.20 |
| 7.2 | " | | " | 90 | Gravel | | 1916 | 8. | 1.00 | | | | | Tie-plates on curves. | 5.20 |
| 7.3 | All | | " | 90 | " | | 1916 | 6. | 0.70 | | | | | | 5.20 |
| 7.4 | None | | " | 66 | Piling Driven in Sand | | 1916 | 6. | 0 | | | Fine | | | 5.20 |
| 7.5 | Yes | | " | 75-85-90 | Cin., Gr., Cl. St | | 1916 | 7. | 2.00 | | | | | | 5.20 |
| 7.6 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| 7.7 | None | | " | 90 | Slag | | 1916 | 8. | 0 | | | | | Mechanical wear ¼ to 1 in. | 48.00 |
| | | | | | FIR | —(DO | UG | LA | S—C | OA | ST | ). | | | |
| | | | | | CARBOLI | NEUM. | | | | | | | | | |
| 1.1 | | 8x8½ | Cut | 75 | Gravel | 6,000,000 | 1916 | 8 | 1.70 | 1.70 | | Good | | | 28.00 |
| | | | | | CREOSOTE. | | | | | | | | | | |
| 2.1 | Goldie G. 58 | 6x8½ | ⅝x6 | G. N. 90 | Gravel Av. 10" | | 1916 | 5⅓ | 59.00 | | | V. Poor | | Removed acct. check and split. Ties are crushing and checking. | 40.10 |
| 2.2 | J. G. 58 " | 6½x8½ 6½x8½ | ⅝x6 | G. N. 90 | " | | 1916 | 5⅓ | 27.00 | | | " | | Removed acct. check and split. Ties are crushing and checking. | 40.10 |

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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | FI | R—( | DOU | GLAS—C | OAST)— | *(Continued)*. | | | | |
| | | | | | | | CREOSOTE. | | | | | | |
| 2.3 | | Sawed | | 1,000 | Oregon or Wash. | 18 to Rl. | | 8.0 | 1908 | O.W.R. &N.C. | Dodson, Ore. | 1% Curve partly on Tangent .35% grade | |
| | | | | | | CR | EOSOTE—( | BOILING) | | | | | |
| 3.1 | | | | 527 | Coast | | | | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 4.1 | 7x9x8 | Sawed | Seasoned | 173 | " | | | 6.2 | 1906 | N.P. | Maywood, Wash. | | |
| 4.2 | 7x9x8 | " | " | 46 | " | | | 6.2 | 1906 | " | " " | | |
| 4.3 | 7x9x8 | " | " | 100 | " | | | 6.2 | 1906 | " | " " | | |
| 4.4 | 7x9x8 | " | " | 71 | " | | | 6.2 | 1906 | " | " " | | |
| 4.5 | 7x9x8 | " | " | 52 | " | | | 6.2 | 1906 | " | " " | | |
| | | | | | | CR | EOSOTE—( | RUEPING). | | | | | |
| 5.1 | | | | 519 | " | | | 12.0 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 6.1 | | | | 156 | " | | | 12.0 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 7.1 | 7x8x8 | Sawed | Seasoned | 137 | Wash Coast | | | | 1911 | C.M.& St.P. | McGregor Ia. | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | FIR—(DOU | GLAS | —C | OA | ST) | —(C | onti | nued). | | | |
| | | | | | CREOSOTE. | | | | | | | | | | |
| 2.3 | | 8x8½ | Cut | C. S. Sect. 75 | Gravel replaced with crushed rock Jan. 1914 | 6,000,000 | 1916 | 8. | 0.20 | | | Good | | Gravel ballast replaced with crushed rock in Jan., 1914. | 28.00 |
| | | | | | | CREOSO | TE | —(B | OILI | NG). | | | | | |
| 3.1 | | | | | | | 1915 | 4. | 0 | | | | | Usual softening and cutting. | 19.00 |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 4.1 | Sellers | 6 3/16x 8½ | Cut | 85 | Gravel | Heavy | 1916 | 10. | 23.00 | | 23.00 | Fair | | Practically all ties not removed were turned in 1916 relaid with 90 lb. steel N. P. standard tie-plates and cut spikes. | 25.00 |
| 4.2 | " | 6 3/16x 8½ | Cut & Screw | 85 | " | " | 1916 | 10. | 20.00 | | 20.00 | " | | | 25.00 |
| 4.3 | " | 6 3/16x 8½ | Screw | 85 | " | " | 1916 | 10. | 9.00 | | 9.00 | " | | | 25.00 |
| 4.4 | None | | Cut | 85 | " | " | 1916 | 10. | 7.00 | | 7.00 | " | | | 25.00 |
| 4.5 | Sellers | 6 3/16x 8½ | " | 85 | " | " | 1916 | 10. | 0 | | | " | | | 25.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 5.1 | | | | | | | 1915 | 4. | 0 | | | | | Usual softening and cutting. | 19.00 |
| | | | | | CR | EOSOTE | AN | D C | RUD | E OI | L. | | | | |
| 6.1 | | | | | | | 1915 | 4. | 0 | | | | | 80% crude oil, 20% creosote. Usual softening and cutting. | 19.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 7.1 | None | | Cut | 65 | Cinder | Average | 1916 | 5. | 0 | | | Fair | | 94.9% good; 5.1% decayed | 6.11 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | FI | R—( | DOU | GLAS—C | OAST)— | *(Cont* | *inued).* | | | |
| | | | | | | | UNTREA | TED. | | | | | |
| 7.2 | 7x8x8 | Sawed | | 500 | Wash. Coast | | | | 1912 | C.M.& St.P. | Groton, S.D. | Tang. | |
| 7.3 | 7x9x8 | " | Sun dried 90 days Seasoned | 1,006 | Ore. or Wash. Coast | 18 to Rl. | | | 1908 | O.W.Ry. &N.Co. | Dodson, Ore. | " | |
| 7.4 | 7x9x8 | " | Not Seasoned | 1,007 | Ore. or Wash. Coast | 18 to Rl. | | | 1908 | " | Dodson, Ore. | " | |
| 7.5 | 7x9x8 | " | Green | 264 | Ore. or Wash. Coast | | | | 1906 | N.P. | Maywood, Wash. | | |
| 7.6 | 7x9x8 | " | " | 46 | Ore. or Wash. Coast | | | | 1906 | " | " " | | |
| 7.7 | 7x9x8 | " | " | 47 | Ore. or Wash. Coast | | | | 1906 | " | " " | | |
| 7.8 | 7x9x8 | " | " | 100 | Ore. or Wash. Coast | | | | 1906 | " | " " | | |
| 7.9 | 7x9x8 | " | " | 100 | Ore. or Wash. Coast | | | | 1906 | " | " " | | |
| 7.10 | 7x9x8 | " | Seasoned | 100 | Ore. or Wash. Coast | | | | 1906 | " | " " | | |
| 7.11 | 7x9x8 | " | Seasoned | 58 | Ore. or Wash. | | | | 1906 | " | Maywood, Wash. | | |
| 7.12 | 7x9x8 | " | " | 96 | Ore. or Wash. | | | | 1906 | " | " " | | |
| 7.13 | 7x9x8 | " | " | 91 | Ore. or Wash. | | | | 1906 | " | " " | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Ser-vice | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | FIR—(DOU | GLAS | —C | OA | ST) | —(*C* | *onti* | *nued*). | | | |
| | | | | | UNTREATED. | | | | | | | | | | |
| 7.2 | Sellers Applied 1914-5x8 | 5x8 | Cut | 90 | Cinder | Heavy | 1916 | 4. | 0 | | | | | 2.4% rotten on top. | 6.11 |
| 7.3 | | 8x8½ | " | C. S. Sect. 75 | Gravel | 6,000,000 | 1916 | 8. | 15.50 | 15.50 | | 30% show surface decay | | Gravel replaced by crushed rock, Jan., 1914. | 28.00 |
| 7.4 | | 8x8½ | " | C. S. Sect. 75 | " | 6,000,000 | 1916 | 8. | 21.45 | | | Fair | | Removed acct. checking and decay. | 28.00 |
| 7.5 | Sellers | | " | 85 | " | Heavy | 1916 | 10 | 88.00 | | | Bad | | 90 lb. steel in 1916, cut spike and N. P. tie-plates. | 25.00 |
| 7.6 | " | | C. & S. | 85 | " | " | 1916 | 10 | 98.00 | | | " | | 90 lb. steel in 1916, cut spike and N. P. tie-plates. | 25.00 |
| 7.7 | " | | " | 85 | " | " | 1916 | 10 | 98.00 | | | " | | 90 lb. steel in 1916, cut spike and N. P. tie-plates. | 25.00 |
| 7.8 | " | | " | 85 | " | " | 1916 | 10. | 89.00 | | | " | | 90 lb. steel in 1916, cut spike and N. P. tie-plates. | 25.00 |
| 7.9 | None | | Cut | 85 | " | " | 1916 | 10 | 100.00 | | | | 7.5 | 90 lb. steel in 1916, cut spike and N. P. tie-plates. | 25.00 |
| 7.10 | Sellers | | C. & S. | 85 | " | " | 1916 | 10 | 86.00 | | | " | | 90 lb. steel in 1916, cut spike and N. P. tie-plates. | 25.00 |
| 7.11 | None | | Screw | 85 | " | " | 1916 | 10 | 97.00 | | | " | | 90 lb. steel in 1916, cut spikes and N. P. tie plates. | 25.00 |
| 7.12 | Sellers | | " | 85 | " | " | 1916 | 10 | 89.00 | | | " | | 90 lb. steel in 1916, cut spikes and N. P. tie plates. | 25.00 |
| 7.13 | " | | C. & S. | 85 | " | " | 1916 | 10 | 85.00 | | | 10% bad 5% fair or poor | | 90 lb. steel in 1916, cut spikes and N. P. tie plates. | 25.00 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | FI | R—( | DOU | GLAS—C | OAST)— | *(Cont* | *inued)*. | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 7.14 | 7x9x8 | Sawed | Seasoned | 350 | Ore. or Wash. | | | | 1906 | N.P. | Maywood, Wash. | | |
| 7.15 | 7x9x8 | " | " | 99 | Ore. or Wash. | | | | 1906 | " | " " | | |
| 7.16 | 7x9x8 | " | " | 284 | Ore. or Wash. | | | | 1906 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 8.1 | 7x9x8 | " | Sun dried 90 days | 977 | Ore. or Wash. Coast | 18 to Rl. | | 0.25 | 1908 | O.W.Ry. &N.Co. | Dodson, Ore. | Tang. | |
| 8.2 | 7x9x8 | " | Not Seasoned | 975 | Ore. or Wash. Coast | 18 to Rl. | | 0.25 | 1908 | " | " | " | |
| 8.3 | 7x9x8 | Hewed | Sun dried 6 mos. | 1,969 | Ore. or Wash. Coast | 18 to Rl. | | 0.25 | 1908 | " | " | " | |
| 8.4 | | | | 45 mi. | Coast | | | | 1903 | S.P. | Nevada | | |
| 8.5 | | | | 36 " | " | | | | 1903 | " | " | | |
| 8.6 | | | | 18 " | " | | | | 1903 | " | Utah | | |
| 8.7 | | | | 20 " | " | | | | 1903 | " | Beppo, Utah | | |
| 8.8 | | | | 6 " | " | | | | 1903 | " | Loy, Utah | | |
| 8.9 | | | | 46 " | " | | | | 1903 | " | Hogup, Utah | | |
| 8.10 | | | | 3 " | " | | | | 1903 | " | Odgen, Utah | | |

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| Index No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | FIR—(DOU GLAS —C OA ST) —(C onti ued). | | | | | | | | | | |
| | | | | | UNTREATED. | | | | | | | | | | |
| 7.14 | Sellers | | Cut | 85 | Gravel | Heavy | 1916 | 10 | 93.00 | | | 5% good 2% poor | | 90 lb. steel in 1916, cut spikes and N. P. tie plates. | 25.00 |
| 7.15 | None | | " | 85 | " | " | 1916 | 10 | 97.00 | | | Bad | | 90 lb. steel in 1916, cut spikes and N. P. tie plates. | 25.00 |
| 7.16 | Sellers | | " | 85 | " | " | 1916 | 10 | 90.00 | | | " | | 90 lb. steel in 1916, cut spikes and N. P. tie plates. | 25.00 |
| | | | | | ZINC CHLOR IDE—(B UR NET T). | | | | | | | | | | |
| 8.1 | | 8x8½ | Cut | C. S. Sect. 75 | Gravel | 6,000,000 | 1916 | 8 | 4.30 | 4.30 | | Generally Sound | | Gravel ballast removed in 1914, and crushed rock placed 1914. | 28.00 |
| 8.2 | | 8x8½ | " | C. S. Sect. 75 | " | 6,000,000 | 1916 | 8 | 4.00 | 4.00 | | Good | | Gravel ballast replaced with crushed rock in 1914. | 28.00 |
| 8.3 | | 8x8½ | " | C. S. Sect. 75 | " | 6,000,000 | 1916 | 8 | 1.26 | 1.26 | | " | | Gravel ballast replaced with crushed rock in 1914. | 28.00 |
| 8.4 | Walhaupter | | | | | | 1916 | 13 | 100.00 | | | | 10-11 | 1219 still in, Oct., 1916, but to come out within 6 months. | 32.10 |
| 8.5 | " | | | | | | 1916 | 13 | 100.00 | | | | 10-11 | | 32.10 |
| 8.6 | | | | | | | 1916 | 13 | 93.00 | | | Decayed and checked | | Ties remaining are decayed on bottom and ends with checks on top. | 32.10 |
| 8.7 | | | | | | | 1916 | 13 | 90.00 | | | Decayed | | Show rot on bottom and ends. | 32.10 |
| 8.8 | | | | | | | 1916 | 13 | 96.00 | | | Decayed and checked | | Decayed and checked. Removed acct. breaking. | 32.10 |
| 8.9 | | | | | | | 1916 | 13 | 40.00 | | | Good | | Those across Great Salt Lake show no rot. | 32.10 |
| 8.10 | " | | | | | | 1916 | 13 | 98.00 | | | Decayed | | | 32.10 |



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## Cross-Tie Records—Service Tests—*(Continued).*

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | FI | R—( | DOU | GLAS—C | OAST)— | (*Cont* | *inued*). | | | |
| | | | | | ZINC C | HLORIDE A | | ND CRUD | E OIL. | | | | |
| 9.1 | 7x8x8 | Sawed | Seasoned-Not bor. for spikes | 93 | Oregon Coast | 23" Centers | Zn.Ch. .78<br>Crd.O. 11.95 | Z. Ch. .25<br>Crd. O. 3.84 | 1906 | S.P. | Tracy, Cal. | Tang. level | |
| 9.2 | 7x9x8 | " | Unseasoned | 140 | Ore. & Cal. C. | 18 to Rl. | Fir<br>Zn.Ch. .2503<br>Crd.O. 7.25<br>W. Y. Pine<br>Zn.Ch. 1.074<br>Crd.O. 16.83 | .0718<br>2.07<br>.307<br>4.81 | 1906 | " | Arbuckle, Cal. | " | 0 |
| | | | | | | FIR— | (DOUGLA | S—MOU | NTAI | N). | | | |
| | | | | | CR | EOSOTE—( | | FULL-CEL | L). | | | | |
| 10.1 | 7x8x8 | Hewed | | 224 | Mts. | 19 to 33' | | 2.750 | 1910 | B.A.&P. | Butte, Mont. | Tang. | |
| 10.2 | 7x9x8 | Hewed Sawed | Seasoned | 74 | Mont. | | | 7.456 | 1905 | C.B.&Q. | Elsberry, Mo. | " | |
| | | | | C | REO | SOTE | —STEAMIN | G—(BET | HELL | ). | | | |
| 11.1 | 7x8x8 | 72% Hewed | Seasoned 14 mos. | 50 | Mont. & Ida. | 19 to 33' | 19.3 | 6.200 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.30 |
| 11.2 | 7x8x8 | 87% Hewed | Seasoned 14 mos. | 100 | Mont. & Ida. | 19 to 33' | 19.3 | 6.200 | 1915 | " | Thompson Falls, Mont. | 1° Curve | 0.30 |
| 11.3 | 7x8x8 | 81.3% Hewed | Seasoned 14 mos. | 150 | Mont. & Ida. | 19 to 33' | 19.3 | 6.200 | 1915 | " | Thompson Falls, Mont. | 1° Curve | 0.36 |
| 11.4 | 7x8x8 | 97.9% Hewed | Seasoned 14 mos. | 95 | Mont. & Ida. | 19 to 33' | 19.3 | 6.200 | 1915 | " | Thompson Falls, Mont. | 1° Curve | 0.36 |
| | | | | | | CRE | OSOTE—(O | PEN-TAN | K). | | | | |
| 12.1 | 7x9x8 | Sawed Hewed | Seasoned | 32 | Mont. | | | 3.990 | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |

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| Service Conditions—*(Continued).* | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | FIR—(DOU | GLAS | —C | OA | ST) | —(C | onti | nued). | | | |
| | | | | | ZINC | CHLORI | DE | AN | D CR | UDE | OIL. | | | | |
| 9.1 | Ribbed | 4½x8 | Cut | 80 | Dirt & Gravel | Very Heavy | 1916 | 10 | 30.10 | | | Sound | | Removed acct. changes in track and rail cut. | 32.10 |
| 9.2 | Rib. to 1915 Changed to Sacto | 4½x8 8x9 | " | 90 | Gravel | " | 1916 | 10 | 2.80 | | | 54.3% Sound 42.8% Partly decayed | | Removed acct rail cut. Douglas fir ties all decayed. (Includes W. Yellow Pine.) | 32.10 |
| | | | | | FIR—( | DOUG | LA | S— | MO | UN | TAI | N). | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 10.1 | Goldie | 5x7 | Cut | 90 | Rock | Heavy cars but not many | 1916 | 6.0 | 0 | | | Sound | | | 24.00 |
| 10.2 | Sellers | | " | | | | 1916 | 11.2 | 5.6 | | | 81% O. K. 13.4% rail worn | | | 5.20 |
| | | | | | CREOSOTE— | STEAMI | NG | —(B | ETH | ELL | ). | | | | |
| 11.1 | N.P.Std. | 7x9 | Cut | 90 | Gravel | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 11.2 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 11.3 | N.P.Std. | 7x9 | " | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 11.4 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| | | | | | CREOSOTE—( | OPEN-T | AN | K). | | | | | | | |
| 12.1 | Sellers | | Cut | | | | 1916 | 11.2 | 9.4 | | | 68.7% good 21.9% rl. cut | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | FIR— | (DO | UGLA | S—MOUN | TAIN)— | (*Cont* | *inued*). | | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 13.1 | 7x9x8 | Sawed Hewed | Seasoned | 40 | Mont. | | | 5.775 | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | | | | UNTRE | ATED. | | | | | |
| | | | | | | (See Ta | marack Index | Nos. 6.5-6.7 | ). | | | | |
| 14.1 | 7x9x8 | Hewed | Green | 95 | " | 18 to Rl. | | | 1907 | N.P. | Plains, Mont. | Tang. | 0.017 |
| 14.2 | 7x9x8 | " | " | 108 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.3 | 7x9x8 | " | Seasoned | 32 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.4 | 7x9x8 | " | " | 90 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.5 | 7x9x8 | " | " | 90 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.6 | 7x9x8 | " | " | 90 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.7 | 7x9x8 | " | " | 90 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.8 | 7x9x8 | " | " | 90 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.9 | 7x9x8 | " | " | 89 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.10 | 7x9x8 | " | Green | 92 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.017 |
| 14.11 | 7x8x8 | 6% Hewed | Seasoned 14 mos. | 50 | Mont. & Ida. | 19 to Rl. | | | 1915 | " | Thompson Falls | 2° Curve | 0.30 |
| 14.12 | | Sawed Triangular | | 856 | Mts. | | | | 1911 | G.N. | Butte Div. | 70% Tang. | |
| 14.13 | | Slabbed | | 1,340 | " | | | | 1911 | " | " | 70% Tang. | |
| 14.14 | 7x9x8 | Hewed Sawed | Seasoned | 89 | Mont. | | | | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | (See Pine | Index | Nos. 4 | 1.8-41.1 | 0; Spruce Ind | ex No. 5.1; | Tamara | ck Index | 7.6 and 7.8). | | |
| 15.1 | 7x9x8 | Sawed | Partly Seasoned | 90 | Mts. | 18 to Rl. | | 0.651 | 1907 | N.P. | Plains, Mont. | Tang. | 0.017 |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-erence No. |
| | | | | F | IR—(DOUGL | AS—M | O | UN | TAI | N)— | (*Co* | *ntinued*). | | | |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 13.1 | Sellers | | Cut | | | | 1916 | 11.2 | 0 | | | 67% good 30% rl. worn 3% doty | | | 5.20 |
| | | | | | (See | UN Tamarac | TR k I | EAT ndex | ED. Nos.6. | 5-6.7 | ). | | | | |
| 14.1 | Wal-haupter & Sellers | | S. & C. | 85 | Gravel | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.6 | | 25.00 |
| 14.2 | Sellers | | " | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.6 | | 25.00 |
| 14.3 | Wood Wal-haupter | | " | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.4 | Wal-haupter | | Cut | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.5 | Sellers | | " | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.6 | " | | " | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.7 | " | | C. & S. | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.8 | " | | Screw | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.9 | N.P. 21 | | Cut | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.7 | | 25.00 |
| 14.10 | Sellers | | " | 85 | " | 8,270,506 | 1916 | 9.3 | 100.00 | | | | 7.6 | | 25.00 |
| 14.11 | N.P.Std. | | " | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 14.12 | Goldie | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | | 40.10 |
| 14.13 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 4.0 | 4.0 | | Poor | | | 40.10 |
| 14.14 | Sellers | | " | | | | 1916 | 11.2 | 53.0 | | | 37% O. K. 7% rl. worn 3% doty | | | 5.20 |
| | | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | |
| | | (See P | ine Ind | ex Nos | 41.8-41.10 Spruc | e Index N | o.5. | 1 an | d Ta | mara | ck In | dex Nos. 7. | 6 a | nd 7.8). | |
| 15.1 | Sellers | | Screw | 85 | Gravel | 8,270,506 | 1916 | 9.3 | 6.7 | | 6.7 | 70% Good | | 22.2% turned over. | 25.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | FIR— | (DO | UGLA | S—MOUN | TAIN)— | *(Cont* | *inued).* | | | |
| | | | | | ZINC | CHLOR | IDE—(BUR | NETT). | | | | | |
| 15.2 | 7x9x8 | Sawed | Partly Seasoned | 107 | Mts. | 18 to Rl. | | 0.651 | 1907 | N.P. | Plains, Mont. | Tang. | 0.017 |
| 15.3 | | | | 3,202 | " | | | 0.500 | 1914 | C.B.&Q. | Douglas, Wyo. | | |
| 15.4 | | | | 3,120 | " | | | | 1906 | " | Kane, Wyo. | | |
| 15.5 | | | | 3,121 | " | | | 0.500 | 1914 | " | Arw Jct., Wyo. | | |
| 15.6 | 7x9x8 | Sawed Hewed | Seasoned | 91 | Mont. | | | 0.262 | 1905 | " | Ellsberry, Mo. | | |
| 15.7 | | Sawed Tri-angular | | 1,635 | Mts. | | | 0.500 | 1911 | G.N. | Butte Div. | 70% Tang. | |
| 15.8 | | Sawed | | 881 | " | | | 0.500 | 1911 | " | " | 70% Tang. | |
| 15.9 | | Slabbed | | 1,286 | " | | | 0.500 | 1911 | " | " | 70% Tang. | |
| 15.10 | | Sawed Tri-angular | | 1,984 | " | | | 0.750 | 1911 | " | " | 70% Tang. | |
| 15.11 | | Sawed | | 819 | " | | | 0.750 | 1911 | " | " | 70% Tang. | |
| 15.12 | | Slabbed | | 1,217 | " | | | 0.750 | 1911 | " | " | 70% Tang. | |
| | | | | | | ZINC C | REOSOTE— | (ALLARD | YCE). | | | | |
| 16.1 | 7x9x8 | Sawed Hewed | " | 41 | " | | | Zn. 0.29 Cre. 1.47 | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | | | FIR— | (WHITE— | Grandis). | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 7x8x8 | Hewed | Seasoned 6-9 mos. | 50 | Mont. & Ida. | 19 to 33' | 28.5 | 9.13 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.3 |
| 1.2 | 7x8x8 | " | Seasoned 6-9 mos. | 51 | Mont. & Ida. | 19 to 33' | 28.5 | 9.13 | 1915 | " | Thompson Falls, Mont. | 2° Curve | 0.4 |
| 1.3 | 7x8x8 | " | Seasoned 6-9 mos. | 49 | Mont. & Ida. | 19 to 33' | 28.5 | 9.13 | 1915 | " | Thompson Falls, Mont. | Tang. | 0.4 |
| 1.4 | 7x8x8 | " | Seasoned 6-9 mos. | 50 | Mont. & Ida. | 19 to 33' | 28.5 | 9.13 | 1915 | " | Thompson Falls, Mont. | " | 0.4 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | F | IR—(DOUGL | AS—M | O | UN | TAI | N)— | (*Co* | *ntinued*). | | | |
| | | | | ZINC | CHLORIDE—( | BURNE | TT | ). | | | | | | | |
| 15.2 | Sellers | | S. & C. | 85 | Gravel | 8,270,506 | 1916 | 9.3 | 7.5 | | 7.5 | 72.9% Good | | 19.6% Turned over. | 25.00 |
| 15.3 | Plated | | Cut | 90 | | | 1916 | 2.0 | 0 | | | | | 0.01% broken. | 5.20 |
| 15.4 | None | | " | 65 | " | | 1916 | 10.0 | 0.03 | | | Good | | | 5.20 |
| 15.5 | Plated | | " | 90 | | | 1916 | 2.0 | 0 | | | " | | | 5.20 |
| 15.6 | Sellers | | " | | " | | 1916 | 11.2 | 14.3 | | | 58.2% good 27.5% rail worn | | | 5.20 |
| 15.7 | Goldie | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | Good | | 4% solution. | 40.10 |
| 15.8 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 4% " | 40.10 |
| 15.9 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 4% " | 40.10 |
| 15.10 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6% " | 40.10 |
| 15.11 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6% " | 40.10 |
| 15.12 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 1.0 | | | " | | 6% " | 40.10 |
| | | | | ZINC | CREOSOTE-(A | LLARD | YC | E). | | | | | | | |
| 16.1 | Sellers | | Cut | | | | 1916 | 11.2 | 14.6 | | | 61% good 22% rl. worn 2.4% doty | | | 5.20 |
| | | | | | FIR—(White | —Grand | is). | | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | N.P.Std. | 7x9 | Cut | 90 | Sand and Gravel | 8,270,506 | 1916 | 1. | 0 | | | Good | | | 25.00 |
| 1.2 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1. | 0 | | | " | | | 25.00 |
| 1.3 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1. | 0 | | | " | | | 25.00 |
| 1.4 | N.P.Std. | 7x9 | " | 90 | " | 8,270,506 | 1916 | 1. | 0 | | | " | | | 25.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | GUM. | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| | | | | | | (See | Beech Index | No. 1.5). | | | | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech Index | Nos. 3.1-3.4 | ). | | | | |
| 1.1 | | Sawed | Seasoned | 390 | | | | 5.00 | 1907 | A.T.& S.F. | Hutchinson, Kan. | | |
| 1.2 | | " | " | 230 | | | | 5.00 | 1907 | " | Plevna, Kan. | | |
| 1.3 | | " | " | 262 | | | | 5.00 | 1907 | " | Hutchinson | | |
| 1.4 | | " | " | 14,497 | | | | 5.00 | 1910 | " | Cut-off | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.11 | ). | | | | |
| 2.1 | 6x8x8 | " | Seasoned 8 mos. | 8 | Ky. | | 1.58 | 5.92 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 2.2 | 6x8x8 | Hewed | Seasoned 8 mos. | 345 | " | | 1.58 | 5.92 | 1912 | " | " | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| | | | | | | (See | Beech Index | No. 10.6). | | | | | |
| | | | | | | ZINC- | TANNIN—( | WELLHO | USE). | | | | |
| 3.1 | | " | Seasoned | 100 | | | 4.22 | | 1897 | N.S. | Norfolk, Va. | Tang. | |
| 3.2 | | " | " | 25 | | | | | 1897 | " | " | 2° Curve | |
| 3.3 | | Sawed | | 100 | | | 1.36 | | 1897 | " | " | Tang. | |
| | | | | | | | GUM— | (Red). | | | | | |
| | | | | | | | CREO | SOTE. | | | | | |
| | | | | | | (See Oa | k Index No. | 15.1 and 1 | 7.3). | | | | |

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| Service Conditions—*(Continued)*. | | | | | | | | Results. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size-In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | | GUM. | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| | | | | | | (See Bee | ch I | ndex | No. 1. | 5). | | | | | |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | | (See Bee | ch I | ndex | Nos. 3. | 1-3.4). | | | | | |
| 1.1 | Yes | 7½x9 | Cut | 90 | Rock | 4.904,181 | 1916 | 9. | 2.6 | 1.0 | 1.6 | | | | 45.10 |
| 1.2 | " | 7½x9 | " | 85 | Cinders | 3,003,686 | 1916 | 9. | 0 | | | | | | 45.10 |
| 1.3 | " | 7½x9 | " | 90 | Rock | 4,904,181 | 1916 | 9. | 1.1 | | 1.1 | | | | 45.10 |
| 1.4 | " | 7½x9 | Screw | 90 | " | 4,904,181 | 1916 | 6. | 0 | | | | | | 45.10 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | | (See Beec | h, | Inde | x Nos. | 9.8- | 9.11 | ). | | | |
| 2.1 | | | | | | | 1916 | 4. | 0 | | | | | No steaming, 75% sap. | 8.10 |
| 2.2 | | | | | | | 1916 | 4. | 0 | | | | | " " 75% " | 8.10 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| | | | | | | (See Bee | ch I | ndex | No. 10. | 6). | | | | | |
| | | | | | ZINC-TANNIN | —(WEL | LH | OUS | E). | | | | | | |
| 3.1 | Servis | | Cut | 70 | Gravel | | 1916 | 19. | 58.0 | | | | | Started to fail in 1907. | 16.10 |
| 3.2 | " | | " | 70 | " | | 1916 | 19. | 80.0 | | | | | " " " " 1907. | 16.10 |
| 3.3 | " | | " | 70 | " | | 1916 | 19. | 77.0 | | | | | " " " " 1905. | 16.10 |
| | | | | | | GUM | —( | Red | ) | | | | | | |
| | | | | | | | CR | EOS | OTE. | | | | | | |
| | | | | | (See | Oak Index | No. | 15.1 | and | 17.3). | | | | | |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties in Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | GUM | —(Red)— | *(Continued).* | | | | | |
| | | | | | | CREO | SOTE—(BE | THELL). | | | | | |
| | | | | | | | (See Oak Ind | ex 12.1). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 4.1 | | | | 85 | | | | 9.83 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 48 | | | | 9.83 | 1909 | " | " West | | |
| 4.3 | 6x8x8 | Sawed | | 28 | | | 33.3 | 12.52 | 1905 | G.H.& S.A. | Bay View, Tex. | | |
| 4.4 | 6x8x8 | " | | 39 | | | 33.3 | 12.52 | 1905 | " | " | | |
| 4.5 | 6x8x8 | " | | 45 | | | 33.3 | 12.52 | 1905 | " | " | | |
| 4.6 | 6x8x8 | " | | 26 | | | 38.45 | 14.45 | 1905 | " | " | | |
| 4.7 | 6x8x8 | " | | 29 | | | 38.45 | 14.45 | 1905 | " | " | | |
| 4.8 | 6x8x8 | " | | 33 | | | 38.45 | 14.45 | 1905 | " | " | | |
| | | | | | | | CREOSOTE | —GIUSSA | NI). | | | | |
| | | | | | | | (See Oak Ind | ex 14.1). | | | | | |
| 5.1 | | | | 18 | | | | | 1905 | St.L.& S.F. | Pacific, Mo. | | |
| | | | | | | CR | EOSOTE—( | REUPING | ). | | | | |
| 6.1 | 6x8x8 | " | Seasoned 2 years | 321 | | | 9.8 | | 1906 | St.L.& S.F. | St. Clair, Mo. | Tang. | |
| | | | | | | DIAM | OND WOOD | PRESERV | ER. | | | | |
| 7.1 | 7x9x8 | Hewed | | 500 | | | Gal. 0.73. | Gal. 0.21 | 1907 | G.H.& S.A. | Ft. Hancock | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 8.1 | | | | 100 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 8.2 | | | | 54 | | | | | 1909 | " | " West | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | | CREOSO | TE | —(B | ETHE | LL). | | | | | |
| | | | | | | (See | Oak | Inde | x 12.1 | ). | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 1.2 | | | | | | 5.20 |
| 4.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 2.1 | | | | | | 5.20 |
| 4.3 | | | Screw | | | | 1916 | 11. | 47.8 | | | | | Started to fail in 1908. | 7.10 |
| 4.4 | Glendon | | | | | | 1916 | 11. | 33.3 | | | | | " " " " 1912. | 7.10 |
| 4.5 | None | | | | | | 1916 | 11. | 53.3 | | | | | " " " " 1912. | 7.10 |
| 4.6 | | | " | | | | 1916 | 11. | 7.7 | | | | | No Steaming. | 7.10 |
| 4.7 | Glendon | | | | | | 1916 | 11. | 17.2 | | | | | " " | 7.10 |
| 4.8 | None | | | | | | 1916 | 11. | 24.2 | | | | | " " | 7.10 |
| | | | | | CR | EOSOTE | —( | GIU | SSAN | I). | | | | | |
| | | | | | (See Oak | | Ind | ex | No. 14 | .1). | | | | | |
| 5.1 | | | | | | | 1916 | 11. | 33.3 | | | | | Incomplete record. Includes red oak. | 30.20 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 6.1 | Yes | 8¼x6½ | Cut | 75-85 | Gravel | 8,300,000 | 1916 | 10. | 0.3 | | | Good | | Tie-plated 1914. Rail changed 1909. Gravel on cinders in 1914. | 30.20 |
| | | | | | DIA | MOND | WO | OD | PRES | ERV | ER. | | | | |
| 7.1 | Glendon | | Cut | | Slag | | 1916 | 9. | 1.7 | | | Good but spikes lopse. | | | 7.10 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 8.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 96.0 | | | | | | 5.20 |
| 8.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 94.5 | | | | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | GUM | —(Red)— | (*Continued*). | | | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 9.1 | | | | 75 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 9.2 | | | | 12 | | | | | 1911 | " | " " | | |
| 9.3 | | | | 43 | | | | | 1909 | " | Lines West | | |
| 9.4 | 6x8x8 | Sawed | | 40 | | | 0.7285 | 0.2738 | 1905 | G.H.& S.A. | Bay View. | | |
| 9.5 | 6x8x8 | " | | 45 | | | 0.7285 | 0.2738 | 1905 | " | " " | | |
| 9.6 | 6x8x8 | " | | 44 | | | 0.7285 | 0.2738 | 1905 | " | " " | | |
| 9.7 | 6x8x8 | " | | 32 | | | 0.8107 | 0.3047 | 1905 | " | " " | | |
| 9.8 | 6x8x8 | " | | 34 | | | 0.8107 | 0.3047 | 1905 | " | " " | | |
| 9.9 | 6x8x8 | " | | 49 | | | 0.8107 | 0.3047 | 1905 | " | " " | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 10.1 | | | | 414 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 10.2 | | | | 232 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 10.3 | | | | 194 | | | | Zn. 0.50 Cre. 3.00 | 1908 | " | Lines East | | |
| | | | | | | | ZINC-CREO | SOTE. | | | | | |
| 11.1 | 6x8x8 | " | | 12 | | | Zn. 1.01 Cr. 17.7 | Zn. 0.27 Cre. 4.49 | 1905 | G.H.& S.A. | Bay View | | |
| 11.2 | 6x8x8 | " | | 16 | | | Zn. 1.01 Cr. 17.7 | Zn. 0.27 Cre. 4.49 | 1905 | " | " " | | |
| 11.3 | 6x8x8 | " | | 17 | | | Zn. 1.01 Cr. 17.7 | Zn. 0.27 Cre. 4.49 | 1905 | " | " " | | |
| | | | | | | | GUM—(T | upelo). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 12.1 | | | | 97 | | | | 10.99 | 1909 | C.B.&Q. | Lines East | | |
| 12.2 | | | | 54 | | | | 10.99 | 1909 | " | Lines West | | |
| 12.3 | 6x8x8 | " | | 33 | | | 29.82 | 11.21 | 1905 | G.H.& S.A. | Bay View | | |
| 12.4 | 6x8x8 | " | | 36 | | | 29.82 | 11.21 | 1905 | " | " " | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GUM—(Red) | —(*Con* | *tinu* | *ed*). | | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 9.1 | Partly | | Cut | 75-85-90 | Cin. Gr., Bt. Cl. | | 1916 | 7. | 21.3 | | | | | | 5.20 |
| 9.2 | Yes | | " | 75 | Gravel | | 1916 | 5. | 0 | | | | | No plates under joints. | 5.20 |
| 9.3 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 18.6 | | | | | | 5.20 |
| 9.4 | | | Screw | | | | 1916 | 11. | 87.5 | | | | | | 7.10 |
| 9.5 | Glendon | | | | | | 1916 | 11. | 100.00 | | | | 6.7 | All out 11 years. | 7.10 |
| 9.6 | None | | | | | | 1916 | 11. | 93.1 | | | | | | 7.10 |
| 9.7 | | | Screw | | | | 1916 | 11. | 87.5 | | | | | | 7.10 |
| 9.8 | Glendon | | | | | | 1916 | 11. | 97.8 | | | | | Started to fail 1909. | 7.10 |
| 9.9 | None | | | | | | 1916 | 11. | 91.8 | | | | | " " " 1909. | 7.10 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 10.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 3.6 | | | | | | 5.20 |
| 10.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0.9 | | | | | | 5.20 |
| 10.3 | " | | " | 90 | Gravel | | 1916 | 8. | 24.2 | | | | | | 5.20 |
| | | | | | | ZINC- | CRE | OS | OTE. | | | | | | |
| 11.1 | | | Screw | | | | 1916 | 11. | 41.6 | | | | | Seasoned 1 year after treat. | 7.10 |
| 11.2 | Glendon | | | | | | 1916 | 11. | 68.7 | | | | | " " " " " | 7.10 |
| 11.3 | None | | | | | | 1916 | 11. | 41.1 | | | | | " " " " " Started to fail in 1910. | 7.10 |
| | | | | | | GUM | —( | Tu | pelo). | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 12.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 0 | | | | | | 5.20 |
| 12.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| 12.3 | | | Screw | | | | 1916 | 11. | 30.3 | | | | | Seasoned 1 year after treat. | 7.10 |
| 12.4 | Glendon | | | | | | 1916 | 11. | 36.0 | | | | | " " " " " | 7.10 |



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## Cross-Tie Records—Service Tests—*(Continued).*

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | GUM—(T | upelo)—( | *Conti* | *nued).* | | | |
| 12.5 | 6x8x8 | Sawed | | 44 | | | 29.82 | 11.21 | 1905 | G.H.& S.A. | Bay View | | |
| 12.6 | 6x8x8 | " | | 23 | | | 35.14 | 13.21 | 1905 | " | " " | | |
| 12.7 | 6x8x8 | " | | 30 | | | 35.14 | 13.21 | 1905 | " | " " | | |
| 12.8 | 6x8x8 | " | | 35 | | | 35.14 | 13.21 | 1905 | " | " " | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 13.1 | | | | 88 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 13.2 | | | | 48 | | | | | 1909 | " | Lines West | | |
| | | | | | ZINC | CHLO | RIDE—(BU | RNETT). | | | | | |
| 14.1 | | | | 76 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 14.2 | | | | 41 | | | | 0.50 | 1909 | " | Lines West | | |
| 14.3 | 6x8x8 | " | | 30 | | | 0.5955 | 0.2239 | 1905 | G.H.& S.A. | Bay View | | |
| 14.4 | 6x8x8 | " | | 37 | | | 0.5955 | 0.2239 | 1905 | " | " " | | |
| 14.5 | 6x8x8 | " | | 46 | | | 0.5955 | 0.2239 | 1905 | " | " " | | |
| 14.6 | 6x8x8 | " | | 33 | | | 0.6224 | 0.234 | 1905 | " | " " | | |
| 14.7 | 6x8x8 | " | | 30 | | | 0.6224 | 0.234 | 1905 | " | " " | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 15.1 | | | | 435 | | | | Zn. 0.50<br>Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 15.2 | | | | 237 | | | | Zn. 0.50 | 1909 | " | Lines West | | |
| 15.3 | 6x8x8 | Sawed | | 12 | | | Zn. 0.5952<br>C. 5.38 | Zn. .2239<br>Cre. 2.02 | 1905 | G.H.& S.A. | | | |
| 15.4 | 6x8x8 | " | | 14 | | | Zn. 0.5952<br>C. 5.38 | Zn. 2239<br>Cre. 2.02 | 1905 | " | Bay View | | |
| 15.5 | 6x8x8 | " | | 16 | | | Zn. 0.5952<br>C. 5.38 | Zn. 2239<br>Cre. 2.02 | 1905 | " | " " | | |
| | | | | | | | HACKBER | RY. | | | | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 1.1 | | | | 47 | | | | Zn. 0.50<br>Cre. 3.00 | 1911 | C.B.&Q. | Utica, Neb. | | |

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| Index No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | GUM—(Tupelo)—(Continued). | | | | | | | | | | |
| 12.5 | None | | | | | | 1916 | 11. | 40.9 | | | | | Seasoned 1 year after treat. | 7.10 |
| 12.6 | | | Screw | | | | 1916 | 11. | 26.1 | | | | | " " " " " | 7.10 |
| 12.7 | Glendon | | | | | | 1916 | 11. | 16.7 | | | | | " " " " " | 7.10 |
| 12.8 | None | | | | | | 1916 | 11. | 45.8 | | | | | " " " " " | 7.10 |
| | | | | | UNTREATED. | | | | | | | | | | |
| 13.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 100.0 | | | | 2.9 | | 5.20 |
| 13.2 | Yes | | " | 75-85-90 | " | | 1915 | 6. | 100.0 | | | | 4.0 | | 5.20 |
| | | | | | ZINC CHLORIDE—(BURNETTIZED). | | | | | | | | | | |
| 14.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 6.6 | | | | | | 5.20 |
| 14.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 2.4 | | | | | | 5.20 |
| 14.3 | | | Screw | | | | 1916 | 11. | 93.2 | | | | | Started to fail 1908. | 7.10 |
| 14.4 | Glendon | | | | | | 1916 | 11. | 97.2 | | | | | " " " 1910. | 7.10 |
| 14.5 | None | | | | | | 1916 | 11. | 93.3 | | | | | " " " 1910. | 7.10 |
| 14.6 | Glendon | | | | | | 1916 | 11. | 90.9 | | | | | " " " 1910. | 7.10 |
| 14.7 | None | | | | | | 1916 | 11. | 89.9 | | | | | " " " 1911. | 7.10 |
| | | | | | ZINC-CREOSOTE—(CARD). | | | | | | | | | | |
| 15.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 2.3 | | | | | | 5.20 |
| 15.2 | Yes | | " | 75-85-90 | " | | 1916 | 7. | 0.4 | | | | | | 5.20 |
| 15.3 | | | Screw | | | | 1916 | 11. | 91.6 | | | | | Started to fail 1910. | 7.10 |
| 15.4 | Glendon | | | | | | 1916 | 11. | 71.4 | | | | | " " " 1911. | 7.10 |
| 15.5 | None | | | | | | 1916 | 11. | 100.0 | | | | 8.5 | " " " 1912. | 7.10 |
| | | | | | HACKBERRY. | | | | | | | | | | |
| | | | | | ZINC-CREOSOTE—(CARD). | | | | | | | | | | |
| 1.1 | None | | Cut | 85 | Burnt Clay | Heavy | 1916 | 5.0 | 0 | | | Good | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | HEM | LOCK—( | Eastern). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 87 | | | | 7.87 | 1909 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 50 | | | | 7.87 | 1910 | " | " " | | |
| 1.3 | | | | 17 | | | | 7.87 | 1911 | " | " " | | |
| 1.4 | | | | 46 | | | | 7.87 | 1909 | " | Lines West | | |
| 1.5 | | | | 52 | | | | 7.87 | 1910 | " | " " | | |
| | | | | | | CRE | OSOTE—(O | PEN-TAN | K). | | | | |
| 2.1 | 6x8x8 | Hewed | Peeled and unpeeled—various seasons | 33 | | 19 to 33′ | | 14.3 | 1907 | C.&N.W. | Janesville, Wis. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 3.1 | | | | 85 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 3.3 | | | | 47 | | | | | 1909 | " | Lines West | | |
| 3.4 | | | | 30 | | | | | 1910 | " | " " | | |
| 3.5 | 6x8x8 | " | Soaked seasoned 29 mos. | 20 | | | | | 1907 | C.&N.W. | Janesville, Wis. | | |
| 3.6 | 6x8x8 | " | Peeled seasoned 26 mos. | 20 | | 19 to 33′ | | | 1907 | " | " " | | |
| 3.7 | 6x8x8 | " | Peeled seasoned 35 mos. | 20 | | 19 to 33′ | | | 1907 | " | " " | | |
| 3.8 | 6x8x8 | " | Unpeeled-seasoned 11 mos. | 50 | | 19 to 33′ | | | 1907 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 4.1 | | | | 70 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 56 | | | | 0.50 | 1910 | " | " " | | |
| 4.3 | | | | 43 | | | | 0.50 | 1909 | " | Lines West | | |
| 4.4 | | | | 45 | | | | 0.50 | 1910 | " | " " | | |
| 4.5 | 6x8x8 | " | Peeled and seasoned 10 mos. | 25 | | 19 to 33′ | | 0.26 | 1907 | C.&N.W. | Janesville, Wis. | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | HEML | OC | K | —(E | aster | n). | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 1.1 | | | | | | 5.20 |
| 1.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 1.3 | Yes | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 1.4 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | | 5.20 |
| 1.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | | 5.20 |
| | | | | | CRE | OSOTE | —( | OP | EN-T | ANK | ). | | | | |
| 2.1 | Wal-haupter | | Cut | 90 | Gravel | | 1916 | 8.5 | 0 | | | 93.9% Good | | 6.1% partly decayed. | 26.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 3.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 100.0 | | | | 4.2 | | 5.20 |
| 3.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 76.0 | | | | | | 5.20 |
| 3.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 95.8 | | | | | | 5.20 |
| 3.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 80.0 | | | | | | 5.20 |
| 3.5 | None | | " | 90 | Sand | Light | 1916 | 8.5 | 100.0 | | | | 6.5 | | 26.00 |
| 3.6 | " | | " | 90 | " | " | 1916 | 8.5 | 95.0 | | | 5% partly decayed | | | 26.00 |
| 3.7 | " | | " | 90 | " | " | 1916 | 8.5 | 100.0 | | | | 6.3 | | 26.00 |
| 3.8 | " | | " | 90 | " | " | 1916 | 8.5 | 88.0 | | | | | 12% decayed and partly decayed. | 26.00 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 2.8 | | | | | | 5.20 |
| 4.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 1.8 | | | | | | 5.20 |
| 4.3 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 4.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 4.5 | Wal-haupter | | " | 90 | Gravel | | 1916 | 8.5 | 16.0 | | | 80% Good | | 4% partly decayed. | 26.00 |

Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | HEM | LOCK—( | Eastern) | —(*Co* | *ntinued* | ). | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 5.1 | | | | 511 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 5.2 | | | | 298 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.3 | | | | 277 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 5.4 | | | | 210 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 5.5 | 7x7x8 | Pole Sawed | Seasoned 8 mos. | 107 | Wis. | 17 to Rl. | | Zn. 0.50 Cre. 2.00 | 1911 | C.M.& St.P. | Bardwell, Wis. | 3° Curve | 0 |
| 5.6 | 8x10x8½ | Hewed | Seasoned | 1,000 | Mich. | 18 to Rl. | | Zn. 0.50 Cre. 2.00 | 1910 | " | Adeline, Ill. | 3° Curve | |
| 5.7 | 7x9x9 | | Seasoned 8 mos. | 132 | " | 18 to Rl. | | Zn. 0.50 Cre. 2.00 | 1908 | " | Braymer, Mo. | 2° Curve | |
| | | | | | | ZINC- | TANNIN—( | WELLHO | USE). | | | | |
| | | | | | (S | ee Tam | arack Index | Nos. 10.1-1 | 0.4 ). | | | | |
| 6.1 | 6x8x8 | " | | 16,197 | | | | 0.50 | 1900 | C.R.I.&P. | Sibley, Ia. | | |
| 6.2 | | | | 142 | | | | Z.C. 0.443 Gel. 0.072 Tan. 0.086 | 1905 | C.&N.W. | Clyman, Wis. | | |
| 6.3 | | | | 10,792 | | | | Z.C. 0.443 Gel. 0.072 Tan. 0.086 | 1905 | " | West Elgin, Ill. | | |
| 6.4 | 6x8x8 | " | Peeled and seasoned 17 mos. | 55 | | 19 to 33' | | 0.532 | 1907 | " | Janesville, Wis. | | |
| 6.5 | 6x8x8 | " | Peeled and seasoned 16.5 mos. | 40 | | 19 to 33' | | 0.564 | 1907 | " | " " | | |
| 6.6 | 6x8x8 | " | Peeled and seasoned 16 mos. | 41 | | 19 to 33' | | 0.408 | 1907 | " | " " | | |
| 6.7 | 6x8x8 | Hewed | Peeled and seasoned 15 mos. | 40 | | 19 to 33' | | 0.464 | 1907 | C.&N.W. | Janesville, Wis. | | |
| 6.8 | 6x8x8 | " | Peeled and seasoned 14 mos. | 40 | | 19 to 33' | | 0.428 | 1907 | " | " " | | |
| 6.9 | 6x8x8 | " | Peeled and seasoned 12 mos. | 37 | | 19 to 33' | | 0.376 | 1907 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | HEMLOCK— | (Easter | n) | —( | *Conti* | *nue* | *d*). | | | | |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 5.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 3.9 | | | | | | 5.20 |
| 5.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 5.3 | Yes | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 1.1 | | | | | | 5.20 |
| 5.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 1.4 | | | | | | 5.20 |
| 5.5 | A. S. Malleable | 4x8 | " | 75 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 84.1% Good | | Includes 8 tamarack. 11.2% badly rail-cut. | 6.11 |
| 5.6 | A. S. Malleable | 5x8 | | 100 | " | " | 1916 | 6.0 | 39.0 | | | | | Removed acct. wreck. No sign of decay. | 6.11 |
| 5.7 | M. I. Sellers | 4x8 5x8 | " | 85 | Burnt Gumbo | " | 1916 | 8.0 | 0 | | | Good | | Inside of curve plated in 1916. Somewhat rail-cut. | 6.11 |
| | | | | | ZINC-TANNIN | —(WEL | LH | OU | SE). | | | | | | |
| | | | | | (See | Tamarack | Ind | ex N | os. 10. | 1-10. | 4). | | | | |
| 6.1 | None | | Cut | 60 | Dirt, Gr. & Cin. | Light | 1916 | 16.0 | 39.2 | | | | | Solution 3.6-4%. | 36.00 |
| 6.2 | | | | | | | 1914 | 9.0 | 30.3 | | | 41.5% good | | 24.6% of ties are fair. | 48.00 |
| 6.3 | | | " | 72 | Gravel | | 1916 | 11.0 | 86.8 | | | | | | 48.00 |
| 6.4 | Sellers | | Screw | 90 | " | Light | 1916 | 8.5 | 10.9 | | | 85.5% good | | 3.6% decayed. | 26.00 |
| 6.5 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 95% good | | 5% partly decayed. | 26.00 |
| 6.6 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 92.7% good | | 7.3% " " | 26.00 |
| 6.7 | Sellers | | Screw | 90 | Gravel | Light | 1916 | 8.5 | 0 | | | 95% Good | | 2.5% partly split. 2.5% partly decayed. | 26.00 |
| 6.8 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.5% Good | | 2.5% decayed. | 26.00 |
| 6.9 | " | | " | 90 | " | " | 1916 | 8.5 | 2.7 | | | 89.2% Good | | 8.1% partly decayed, decayed and partly split. | 26.00 |

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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | HEM | LOCK—( | Eastern) | —(*Co* | *ntinued* | ). | | |
| 6.10 | 6x8x8 | Hewed | Peeled and seasoned 11 mos. | 41 | | 19 to 33′ | | 0.340 | 1907 | C.&N.W. | Janesville, Wis. | | |
| 6.11 | 6x8x8 | " | Peeled and seasoned 11 mos. | 40 | | 19 to 33′ | | 0.384 | 1907 | " | " " | | |
| 6.12 | 6x8x8 | " | Unpeeled and seasoned 17 m. | 24 | | 19 to 33′ | | 0.728 | 1907 | " | " " | | |
| 6.13 | 6x8x8 | " | Unpeeled and seasoned 16 m. | 25 | | 19 to 33′ | | 0.60 | 1907 | " | " " | | |
| 6.14 | 6x8x8 | " | Unpeeled and seasoned 12 m. | 40 | | 19 to 33′ | | 0.592 | 1907 | " | " " | | |
| 6.15 | 6x8x8 | " | Soaked and seasoned 17 m. | 47 | | 19 to 33′ | | 0.516 | 1907 | " | " " | | |
| 6.16 | 6x8x8 | " | Soaked and seasoned 17 m. | 40 | | 19 to 33′ | | 0.468 | 1907 | " | " " | | |
| 6.17 | 6x8x8 | " | Peeled and seasoned 16.5 mos. | 40 | | 19 to 33′ | | 0.564 | 1907 | " | " " | | |
| 6.18 | 6x8x8 | " | Peeled and seasoned 16 mos. | 40 | | 19 to 33′ | | 0.428 | 1907 | " | " " | | |
| 6.19 | 6x8x8 | " | Peeled and seasoned 10 mos. | 40 | | 19 to 33′ | | 0.512 | 1907 | " | " " | | |
| 6.20 | 6x8x8 | " | Peeled and seasoned 14 mos. | 40 | | 19 to 33′ | | 0.428 | 1907 | " | " " | | |
| 6.21 | 6x8x8 | " | Peeled and seasoned 12 mos. | 40 | | 19 to 33′ | | 0.452 | 1907 | " | " " | | |
| 6.22 | 6x8x8 | " | Peeled and seasoned 11 mos. | 40 | | 19 to 33′ | | 0.352 | 1907 | " | " " | | |
| 6.23 | 6x8x8 | " | Peeled and seasoned 11 mos. | 39 | | 19 to 33′ | | 0.448 | 1907 | " | " " | | |
| 6.24 | 6x8x8 | " | Unpeeled and seasoned 17 m. | 25 | | 19 to 33′ | | 0.728 | 1907 | " | " " | | |
| 6.25 | 6x8x8 | " | Unpeeled and seasoned 14 m. | 25 | | 19 to 33′ | | 0.584 | 1907 | " | " " | | |
| 6.26 | 6x8x8 | " | Unpeeled and seasoned 10 m. | 40 | | 19 to 33′ | | 0.512 | 1907 | " | " " | | |
| 6.27 | 6x8x8 | " | Soaked and seasoned 16 m. | 44 | | 19 to 33′ | | 0.476 | 1907 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | HEMLOCK— | (Easter | n) | —( | *Conti* | *nue* | *d*). | | | | |
| 6.10 | Sellers | | Screw | 90 | Gravel | Light | 1916 | 8.5 | 9.8 | | | 75.6% Good | | 12.2% decayed and partly decayed. 2.4% partly split. | 26.00 |
| 6.11 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 90% Good | | 7.5% partly decayed; 2.5% partly split. | 26.00 |
| 6.12 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 95.8% Good | | 4.2% partly decayed. | 26.00 |
| 6.13 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 88% Good | | 4% partly decayed; 8% partly split. | 26.00 |
| 6.14 | " | | " | 90 | " | " | 1916 | 8.5 | 2.5 | | | 90% Good | | 5% decayed and partly decayed; 2.5% partly split. | 26.00 |
| 6.15 | " | | " | 90 | " | " | 1916 | 8.5 | 2.1 | | | 89.3% Good | | 8.5% decayed and partly decayed. | 26.00 |
| 6.16 | " | | " | 90 | " | " | 1916 | 8.5 | 2.5 | | | 90% Good | | 5% partly decayed; 2.5% partly split. | 26.00 |
| 6.17 | " | | " | 90 | " | " | 1916 | 8.5 | 5.0 | | | 87.5% Good | | 7.5% partly decayed. | 26.00 |
| 6.18 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 95% Good | | 5% partly decayed. | 26.00 |
| 6.19 | " | | Cut | 90 | " | " | 1916 | 8.5 | 0 | | | 97.5% Good | | 2.5% decayed. | 26.00 |
| 6.20 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.5% Good | | 2.5% partly decayed. | 26.00 |
| 6.21 | " | | " | 90 | " | " | 1916 | 8.5 | 2.5 | | | 95% Good | | 2.5% partly decayed. | 26.00 |
| 6.22 | " | | " | 90 | " | " | 1916 | 8.5 | 5.0 | | | 82.5% Good | | 5% partly decayed; 7½% partly split. | 26.00 |
| 6.23 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 6.24 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 6.25 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 6.26 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.5% Good | | 2.5% partly decayed. | 26.00 |
| 6.27 | " | | " | 90 | " | " | 1916 | 8.5 | 2.3 | | | 93.2% Good | | 4.6% decayed. | 26.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | HEM | LOCK—( | Eastern) | —(*Co* | *ntinued* | ). | | |
| 6.28 | 6x8x8 | Hewed | Peeled and seasoned 17 mos. | 39 | | 19 to 33′ | | 0.516 | 1907 | C.&N.W. | Janesville, Wis. | | |
| 6.29 | 6x8x8 | " | Peeled and seasoned 16 mos. | 41 | | 19 to 33′ | | 0.556 | 1907 | " | " " | | |
| 6.30 | 6x8x8 | " | Peeled and seasoned 15 mos. | 43 | | 19 to 33′ | | 0.452 | 1907 | " | " " | | |
| 6.31 | 6x8x8 | " | Peeled and seasoned 14 mos. | 39 | | 19 to 33′ | | 0.448 | 1907 | " | " " | | |
| 6.32 | 6x8x8 | " | Peeled and seasoned 13 mos. | 40 | | 19 to 33′ | | 0.388 | 1907 | " | " " | | |
| 6.33 | 6x8x8 | " | Peeled and seasoned 12 mos. | 40 | | 19 to 33′ | | 0.376 | 1907 | " | " " | | |
| 6.34 | 6x8x8 | " | Peeled and seaseasoned 11 mos. | 40 | | 19 to 33′ | | 0.428 | 1907 | " | " " | | |
| 6.35 | 6x8x8 | " | Peeled and seasoned 10 mos. | 40 | | 19 to 33′ | | 0.388 | 1907 | " | " " | | |
| 6.36 | 6x8x8 | " | Unpeeled and seasoned 16 m. | 25 | | 19 to 33′ | | 0.564 | 1907 | " | " " | | |
| 6.37 | 6x8x8 | " | Unpeeled and seasoned 13 m. | 21 | | 19 to 33′ | | 0.484 | 1907 | " | " " | | |
| 6.38 | 6x8x8 | " | Unpeeled and seasoned 10 m. | 40 | | 19 to 33′ | | 0.544 | 1907 | " | " " | | |
| 6.39 | 6x8x8 | " | Unpeeled, soaked, seasoned 15 mos. | 49 | | 19 to 33′ | | 0.500 | 1907 | " | " " | | |
| 6.40 | 6x8x8 | " | Peeled and unpeeled seasoned 10 m. | 53 | | 19 to 33′ | | 0.356 | 1907 | " | " " | | |
| 6.41 | 6x8x8 | " | Peeled and unpeeled seasoned 18 m. | 51 | | 19 to 33′ | | 0.356 | 1907 | " | " " | | |
| 6.42 | 6x8x8 | " | Peeled, unpeeled, seasoned 10 mos. | 51 | | 19 to 33′ | | 0.436 | 1907 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | HEMLOCK— | (Easter | n) | —( | *Conti* | *nue* | *d*). | | | | |
| 6.28 | Walhaupter | | Cut | 90 | Gravel | Light | 1916 | 8.5 | 0 | | | 87.2% Good | | 10.2% decayed and partly decayed; 2.6% partly split. | 26.00 |
| 6.29 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.6% Good | | 2.4% decayed. | 26.00 |
| 6.30 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 6.31 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.4% Good | | 2.6% partly decayed. | 26.00 |
| 6.32 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 95% Good | | 5% partly decayed. | 26.00 |
| 6.33 | " | | " | 90 | " | " | 1916 | 8.5 | 2.5 | | | 87.5% Good | | 10% partly decayed. | 26.00 |
| 6.34 | " | | " | 90 | " | " | 1916 | 8.5 | 2.5 | | | 95% Good | | 2.5% partly decayed. | 26.00 |
| 6.35 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 85% Good | | 15% decayed and partly decayed. | 26.00 |
| 6.36 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 72% Good | | 28% partly decayed. | 26.00 |
| 6.37 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 90.5% Good | | 9.5% partly decayed. | 26.00 |
| 6.38 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.5% Good | | 2.5% decayed. | 26.00 |
| 6.39 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 93.9% Good | | 6.1% partly decayed. | 26.00 |
| 6.40 | " | | " | 90 | " | " | 1916 | 8.5 | 7.5 | | | 81.2% Good | | 11.3% decayed and partly decayed. | 26.00 |
| 6.41 | " | | " | 90 | " | " | 1916 | 8.5 | 5.8 | | | 80.4% Good | | 11.8% decayed and partlye decayed; 2% partly split. | 26.00 |
| 6.42 | " | | " | 90 | " | " | 1916 | 8.5 | 4.0 | | | 80.4% Good | | 15.6% decayed and partly decayed. | 26.00 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | HEM | LOCK—( | Western). | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.1 | 7x9x8 | Hewed | Green | 100 | Wash. | | | | 1906 | N.P. | Maywood, Wash. | Tang. | .96 |
| 1.2 | 7x9x8 | " | " | 103 | " | | | | 1906 | " | " " | Tang. | .46 |
| | | | | | | | HICKORY | —(Pignut | ). | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 4 | | | | | 1910 | C.B.&Q. | Blanding, Ill. | | |
| 1.2 | | | | 14 | | | | | 1910 | " | Barr, Colo. | | |
| 1.3 | | | | 6 | | | | | 1910 | " | Hanover, Ill. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 2.1 | | | | 65 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 2.2 | | | | 30 | | | | | 1909 | " | Lines West | | |
| 2.3 | | | | 9 | | | | | 1910 | " | Lines East | | |
| 2.4 | | | | 15 | | | | | 1910 | " | Lines West | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 3.1 | | | | 4 | | | | 0.50 | 1910 | C.B.&Q. | Blanding, Ill. | | |
| 3.2 | | | | 15 | | | | 0.50 | 1910 | " | Barr, Colo. | | |
| 3.3 | | | | 5 | | | | 0.50 | 1910 | " | Hanover, Ill. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 4.1 | | | | 164 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 89 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 4.3 | | | | 20 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines East | | |
| 4.4 | | | | 16 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines West | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | HEMLOCK— | (Weste | rn | ). | | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | Sellers | | Cut | 85 | Gravel | Heavy | 1915 | 8.5 | 100.0 | | | | 7.3 | | 25.00 |
| 1.2 | None | | " | 85 | " | " | 1915 | 8.5 | 100.0 | | | | 7.3 | | 25.00 |
| | | | | | HICKORY— | (Pignut | ). | | | | | | | | |
| | | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 1.2 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| 1.3 | " | | " | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 2.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 69.2 | | | | | | 5.20 |
| 2.2 | All | | " | 75-85-90 | " | | 1916 | 7.0 | 90.0 | | | | | | 5.20 |
| 2.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 77.8 | | | | | | 5.20 |
| 2.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 60.0 | | | | | | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 3.1 | All | | Cut | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 3.2 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| 3.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 4.1 | Partly | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 4.3 | | | | | | 5.20 |
| 4.2 | All | | " | 85-90 | " | | 1916 | 7.0 | 6.7 | | | | | | 5.20 |
| 4.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 4.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |

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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | JUNIPER. | | | | | | | |
| | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | | |
| 1.1 | | Hewed | Seasoned 10 mos. | 25 | | | | 8 | 1897 | N.S. | Norfolk, Va. Div. | 2° Curve | |
| 1.2 | | | Seasoned 10 mos. | 75 | | | | 8 | 1897 | " | " " " | Tang. | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 2.1 | | " | Seasoned 14 mos. | 100 | | | | | 1897 | " | Norfolk, Va. Div. | Tang. | |
| 2.2 | | " | Seasoned 14 mos. | 100 | | | | | 1897 | N.S. | " " " | " | |
| 2.3 | | " | Seasoned 14 mos. | 100 | | | | | 1897 | " | " " " | " | |
| 2.4 | | " | Seasoned 14 mos. | 100 | | | | | 1897 | " | " " " | " | |
| 2.5 | | " | Seasoned 14 mos. | 100 | | | | | 1897 | " | " " " | " | |
| 2.6 | | " | Seasoned 14 mos. | 120 | | | | | 1897 | " | " " " | " | |
| 2.7 | | " | Seasoned 14 mos. | 100 | | | | | 1897 | " | " " " | " | |
| 2.8 | | " | Seasoned 14 mos. | 200 | | | | | 1897 | " | " " " | " | |
| | | | | | | LAR | CH—(Wes | tern) | | | | | |
| | | | | | CRE | OSOTE | —STEAMIN | G—(BETH | ELL). | | | | |
| 1.1 | 7x8x8 | 18% Hewed 82% Sawed | Seasoned 14 mos. | 50 | Mont. & Ida. | 19 to Rl. | 28.2 | 9.05 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.300 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | JUNIPER—(*Continued*). | | | | | | | | | | |
| | | | | | CREOSOTE—(FULL-CELL). | | | | | | | | | | |
| 1.1 | Yes | | Cut | 70 | Gravel | | 1916 | 19.0 | 52.0 | | | | | Started to fail in 1909. Piled 5 mos. after treatment; 50% tie-plated. | 16.10 |
| 1.2 | " | | " | 70 | " | | 1916 | 19.0 | 11.0 | | | | | Piled 5 mos. after treatment; 50% tie-plated. Started to fail in 1911. | 16.10 |
| | | | | | | UNTREATED. | | | | | | | | | |
| 2.1 | Felt | | Cut | 70 | Gravel | | 1916 | 19.0 | 87.0 | | | | | Started to fail 1908. | 16.10 |
| 2.2 | | | Lags & Clips | 70 | " | | 1916 | 19.0 | 78.0 | | | | | " " " 1908. | 16.10 |
| 2.3 | | | Cut | 70 | " | | 1916 | 19.0 | 77.0 | | | | | Ties covered—ballast. | 16.10 |
| | | | | | | | | | | | | | | ½ of tie in ballast—sloped to ends. Started to fail 1907. | 16.10 |
| 2.4 | Goldie | | " | 70 | " | | 1916 | 19.0 | 75.0 | | | | | Started to fail 1905. Ballast top of tie at center. | 16.10 |
| 2.5 | | | " | 70 | " | | 1916 | 19.0 | 73.0 | | | | | Started to fail 1907. Ballast 2" wide at center of slope. | 16.10 |
| 2.6 | | | " | 70 | " | | 1916 | 19.0 | 79.0 | | | | | | |
| 2.7 | | | " | 70 | " | | 1916 | 19.0 | 63.0 | | | | | Started to fail 1905. | 16.10 |
| 2.8 | | | " | 70 | " | | 1916 | 19.0 | 82.5 | | | | | Started to fail 1901. | 16.10 |
| | | | | | LARCH—(Western). | | | | | | | | | | |
| | | | | | CREOSOTE—STEAM | | | | | | | | | | |
| 1.1 | N.P.Std. | 7x9 | Cut | 90 | Gravel and Sand | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | LAR | CH—(Wes | tern)—(C | *ontin* | *ued*). | | | |
| 1.2 | 7x8x8 | 98% Hewed 2% Sawed | Seasoned 14 mos. | 101 | Mont. & Ida. | 19 to Rl. | 28.2 | 9.05 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.300 |
| 1.3 | 7x8x8 | 47% Hewed 53% Sawed | Seasoned 14 mos. | 150 | Mont. & Ida. | 19 to Rl. | 28.2 | 9.05 | 1915 | " | Thompson Falls, Mont. | 1° Curve | 0.360 |
| 1.4 | 7x8x8 | 99% Hewed 1% Sawed | Seasoned 14 mos. | 71 | Mont. & Ida. | 19 to Rl. | 28.2 | 9.05 | 1915 | " | Thompson Falls, Mont. | 1° Curve | 0.360 |
| | | | | | | | UNTRE | ATED. | | | | | |
| | | | | | | (See Ta | marack Index | Nos. 6.5-6.9 | ). | | | | |
| 2.1 | 7x9x8 | Hewed | Seasoned | 90 | Mts. | 18 to Rl. | | | 1907 | N.P. | Plains, Mont. | Tang. | 0.0170 |
| 2.2 | 7x9x8 | " | " | 90 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.0170 |
| 2.3 | 7x9x8 | " | Unseasoned | 92 | " | 18 to Rl. | | | 1907 | " | " " | " | 0.0170 |
| 2.4 | 7x8x8 | 10% Hewed 90% Sawed | Seasoned 14 mos. | 50 | Mont. & Ida. | 19 to Rl. | | | 1915 | " | Thompson Falls, Mont. | 2° Curve | 0.300 |
| 2.5 | | Triang. | | 1,469 | | | | | 1911 | G.N. | Butte, Div. | 70% Tang. 30% Curve | |
| 2.6 | | Sawed Square | | 1,277 | | | | | 1911 | " | " " | 70% Tang. 30% Curve | |
| 2.7 | | Slabbed | | 1,236 | | | | | 1911 | " | " " | 70% Tang. 30% Curve | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See Ta | marack Index | Nos. 7.6-7.8 | ). | | | | |
| 3.1 | 7x9x8 | Hewed | Seasoned | 101 | Mts. | 18 to Rl. | | 0.874 | 1907 | N.P. | Plains, Mont. | Tang. | 0.0170 |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates Kind | Tie Plates Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l Decay % | Cause R'm'v'l Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | LARCH—(Western)—(*Continued*). | | | | | | | | | | |
| 1.2 | Vignoles bolted to | Rail Chairs ties | | 90 | Gravel and Sand | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 1.3 | N.P.Std. | 7x9 | Cut | 90 | " | 8.270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 1.4 | Vignoles bolted to | Rail Chairs ties | | 90 | " | 8.270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| | | | | | UNTREATED. | | | | | | | | | | |
| | | | | | (See Tamarack Ind ex Nos. 6.5- 6.9). | | | | | | | | | | |
| 2.1 | Sellers | | S. & C. | 85 | Gravel | 8,270,506 | 1916 | 9.3 | 100.0 | | | | 7.4 | | 25.00 |
| 2.2 | " | | Screw | 85 | " | 8,270,506 | 1916 | 9.3 | 100.0 | | | | 7.4 | | 25.00 |
| 2.3 | " | | " | 85 | " | 8,270,506 | 1916 | 9.3 | 100.0 | | | | 7.3 | | 25.00 |
| 2.4 | N.P.Std. | 7x9 | Cut | 90 | Gravel and Sand | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 2.5 | Goldie | 6x8½ | ⅝x6 | 90 | Gravel 10 in. | | 1916 | 5.3 | 4.0 | | | | | Removed acct. decay and split. | 40.10 |
| | J. G. 58 | 6½x8½ | | | | | | | | | | Fair | | About 35% to come out in 1917. | 40.10 |
| | J. G. 58 | 6½x8½ | | | " | | 1916 | 5.3 | 4.0 | 4.0 | | Poor | | Large renewals in 1917. | 40.10 |
| 2.6 | Goldie | 6x8½ | ⅝x6 | 90 | | | | | | | | | | | |
| | J. G. 58 | 6½x8½ | | | " | | 1916 | 5.3 | 1.0 | 1.0 | | 59.4% Good | | 1% split, 4% partly split, 35.6% turned over. | 25.00 |
| 2.7 | Goldie | 6x8½ | ⅝x6 | 90 | | | | | | | | | | | |
| | | | | | ZINC CHLORIDE—(Burnett). | | | | | | | | | | |
| | | | | | (See Tamarack Ind ex Nos. 7.6- 7.8). | | | | | | | | | | |
| 3.1 | Sellers | | Screw | 85 | Gravel | 8,270,506 | 1916 | 9.3 | 1.0 | | | 59.4% Good | | 1% split, 4% partly split. 35.6% turned over. | 25.00 |



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"Cross-Tie Records—Service Tests—(*Continued*).

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | LA | RCH | —(WEST | ERN)—*C* | *ontin* | *ued*). | | | |
| 3.2 | 7x9x8 | Hewed | Seasoned | 92 | Mts. | 18 to Rl. | | 0.874 | 1907 | N.P. | Plains, Mont | Tang. | 0.0170 |
| 3.3 | | Sawed Triang. | | 1,228 | | | | 0.500 | 1911 | G.N. | Butte Div. | Tang. 70% Curve 30% | |
| 3.4 | | Slabbed | | 1,273 | | | | 0.500 | 1911 | " | Butte, Mont. | Tang. 70% Curve 30% | |
| 3.5 | | Sawed Square | | 1,318 | | | | 0.500 | 1911 | " | " " | Tang. 70% Curve 30% | |
| 3.6 | | Sawed Triang. | | 2,053 | | | | 0.750 | 1911 | " | " " | Tang. 70% Curve 30% | |
| 3.7 | | Slabbed | | 1,433 | | | | 0.750 | 1911 | " | " " | Tang. 70% Curve 30% | |
| | | | | | | | MAPLE. | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| | | | | | | (See | Beech Index | No. 1.6). | | | | | |
| 1.1 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 12.0 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 1.2 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 12.0 | 1911 | " | " " | " " | 0 |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| | | | | | (See | Beech, | Index No. | 2.1, and Oa | k 16.3 | -16.28). | | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | (See | Beech Index | Nos. 3.2-3.3 | ). | | | | |
| 2.1 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 4.9 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 2.2 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 4.9 | 1911 | " | " " | " " | 0 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | LARCH—(W | estern) | —( | *Co* | *ntinu* | *ed*). | | | | | |
| 3.2 | Sellers | | S. & C. | 85 | Gravel | 8,270,506 | 1916 | 9.3 | 10.9 | | | 60.8% Good | | Removed acct. split. 3.3% partly split, 25% turned over. | 25.00 |
| 3.3 | Goldie G. 58<br>J. G. 58 | 6x8½<br>6½x8½ | ⅝x6 | 90 | Gravel 10 in. | | 1916 | 5.3 | 0 | | | Good | | 4% Zinc Chloride Solution. | 40.10 |
| 3.4 | Goldie | 6x8½<br>6½x8½ | ⅝x6 | 90 | Gravel 10 in. | | 1916 | 5.3 | 0 | | | " | | 4% Zinc Chloride Solution. | 40.10 |
| 3.5 | " | 6x8½<br>6½x8½ | ⅝x6 | 90 | " | | 1916 | 5.3 | 1.0 | 1.0 | | " | | 4% Zinc Chloride Solution. | 40.10 |
| 3.6 | " | 6x8½<br>6½x8½ | ⅝x6 | 90 | Gravel 10 in. | | 1916 | 5.3 | 0 | | | " | | 6% Zinc Solution. | 40.10 |
| 3.7 | " | 6x8½<br>6½x8½ | ⅝x6 | 90 | Gravel 10 in. | | 1916 | 5.3 | 0 | | | " | | 6% Zinc Solution. | 40.10 |
| | | | | | MAPLE. | | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| | | | | | | (See Bee | ch | Inde | x No. | 1.6). | | | | | |
| 1.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 96% Good | | 4% partly split and partly decayed. | 27.00 |
| 1.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 96% Good | | 4% partly split and partly decayed. | 27.00 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| | | | | | (See Beech, | Index N | o. | 2.1 | and | Oak, | 16.3- | 16.28). | | | |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | (See Beech Index | Nos. 3.2- | 3.3 | ). | | | | | | | |
| 2.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 99% Good | | 1% partly split. | 27.00 |
| 2.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 99% Good | | 1% " " | |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | MAPLE—( | *Continued* | | ). | | | | | |
| | | | | OIL | SEMI- | REFIN | ED—PARAF | FIN BASE | —(FU | LL-CEL | L). | | |
| 3.1 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 12.6 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 3.2 | 6x8x8 | | Seasoned | 50 | N. E. Wis. | 18 to Rl. | | 12.6 | 1911 | " | " " | " " | 0 |
| | | | | | | | UNTRE | ATED. | | | | | |
| 4.1 | 6x8x8 | | " | 50 | N. E. Wis. | 18 to Rl. | | | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 4.2 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | | 1911 | " | " " | " " | 0 |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Beech Index | Nos. 9.8-9.11 | ). | | | | |
| 5.1 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 0.50 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 5.2 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | 0.50 | 1911 | " | " " | " " | 0 |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 6.1 | 7x9x9 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | 10 | Zn. 0.37 Cre. 3.10 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 6.2 | 7x9x9 | | Seasoned 6-18 mos. | 225 | | 18 to Rl. | | Zn. 0.37 Cre. 3.10 | 1911 | " | " " | " " | 0 |
| 6.3 | 6x8x8 | | | 325 | | 18 to Rl. | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | " " | 0 |
| 6.4 | 6x8x8 | | | 125 | | | | Zn. 0.50 Cre. 2.00 | 1908 | " | " " | | |
| 6.5 | 6x8x8 | | | | | | | Zn. 0.50 Cre. 2.00 | 1908 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | MAPLE—( *Continu* | | *ed* | ). | | | | | | | |
| | | | | | OIL SEMI-REFINED | —PARA | FFI | N | BASE | —(F | ULL | -CELL). | | | |
| 3.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 98% Good | | 2% partly split. | 27.00 |
| 3.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 98% Good | | 2% " " | 27.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 4.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 36.0 | 36.0 | | 9% Good | | 54% partly decayed; 1% partly split. | 27.00 |
| 4.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 36.0 | 36.0 | | 9% Good | | 54% partly decayed; 1% partly split. | 27.00 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | | | (See Beec | h, | Inde | x Nos. | 9.8- | 9.11 | ). | | | |
| 5.1 | None | | Cut | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 99% Good | | 1% partly split. | 27.00 |
| 5.2 | Economy | 7½x9 | Screw | 90 | " | " | 1916 | 5.0 | 0 | | | 99% Good | | 1% " " | 27.00 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 6.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 99% Good | | 20% Creosote; 80% Zinc Chloride; 1% partly split. | 27.00 |
| 6.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 99% Good | | 20% Creosote; 80% Zinc Chloride; 1% partly split. | 27.00 |
| 6.3 | | | " | 90 | Slag | | 1916 | 8.0 | 1.3 | | | | | Mechanical wear ⅛ to ½. | 48.00 |
| 6.4 | | | " | 90 | " | | 1916 | 8.0 | 0 | | | | | | 48.00 |
| 6.5 | | | " | 90 | " | | 1916 | 8.0 | 0 | | | | | | 48.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | MAPLE—( | *Continued* | ). | | | | |
| | | | | | | ZINC- | CREOSOTE | —TWO MO | VEME | NT). | | | |
| 7.1 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | Emulsion 15.5 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. level | 0 |
| 7.2 | 6x8x8 | | Seasoned 6-18 mos. | 50 | N. E. Wis. | 18 to Rl. | | Emulsion 15.5 | 1911 | " | " " | " " | 0 |
| | | | | | | | MAPLE—( | Hard). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 8.1 | | | | 30 | | | | 5.92 | 1909 | C.B.&Q. | Lines East | | |
| 8.2 | | | | 18 | | | | 5.92 | 1909 | " | Lines West | | |
| 8.3 | | | | 50 | | | | 5.92 | 1909 | " | Lines East | | |
| 8.4 | | | | 15 | | | | 5.92 | 1910 | " | Lines West | | |
| 8.5 | | | | 15 | | | | 5.92 | 1911 | " | Lines East | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 9.1 | | | | 52 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 9.2 | | | | 30 | | | | | 1909 | " | Lines West | | |
| 9.3 | | | | 24 | | | | | 1910 | " | Lines East | | |
| 9.4 | | | | 15 | | | | | 1910 | " | Lines West | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 10.1 | | | | 30 | | | | 0.50 | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 10.2 | | | | 20 | | | | 0.50 | 1910 | " | Blanding, Ill. | | |
| 10.3 | | | Seasoned yr. after treatment | 15 | | | | 0.50 | 1910 | " | Barr, Colo. | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Service Conditions—(Continued). Inspected | Time Service | Results. Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | MAPLE—( | *Continu* | *ed* | ). | | | | | | | |
| | | | | ZINC- | CREOSOTE—( | TWO | MO | VE | MEN | T). | | | | | |
| 7.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 99% Good | | 1% partly split. Special treatment. 3% Zn. Ch. + Creosote. | 27.00 |
| 7.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 99% Good | | 1% partly split. Special treatment. 3% Zn. Ch. + Creosote. | 27.00 |
| | | | | | MAPLE— | (Hard | ). | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 8.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 8.2 | Yes | | " | 85-90 | " | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 8.3 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 8.4 | Yes | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 8.5 | Except under joints | | " | 75 | Gravel | | 1916 | 5.0 | 0 | | | | | | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 9.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1915 | 6.0 | 100.0 | | | | 3.8 | | 5.20 |
| 9.2 | Yes | | " | 85-90 | " | | 1916 | 7.0 | 100.0 | | | | 4.7 | | 5.20 |
| 9.3 | All | | " | 90 | Gravel | | 1916 | 6.0 | 87.5 | | | | | | 5.20 |
| 9.4 | Yes | | " | 90 | Lyons Stone | | 1916 | 6.0 | 53.3 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 10.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 10.2 | " | | " | 90 | " | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 10.3 | Yes | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | ZINC | MAPLE—( | Hard)—( —(CARD). | *Conti* | *nued*). | | | |
| | | | | | | | CREOSOTE | | | | | | |
| 11.1 | | | | 386 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 11.2 | | | | 207 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 11.3 | | | | 175 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines East | | |
| 11.4 | | | | 65 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines West | | |
| 11.5 | | | | 550 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | Utica, Neb. | | |
| 11.6 | 7x9x9 | | Seasoned 8 mos. | 464 | N. Mich. | 18 to Rl. | 10 | Zn. 0.50 Cre. 2.00 | 1908 | C.M.& St.P. | Braymer, Mo. | 2° | |
| | | | | | | | MAPLE—( | Soft). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 12.1 | | | | 88 | | | | 17.80 | 1909 | C.B.&Q. | Lines East | | |
| 12.2 | | | | 48 | | | | 17.80 | 1910 | " | Lines West | | |
| 12.3 | | | | 50 | | | | 17.80 | 1910 | " | Lines East | | |
| 12.4 | | | | 15 | | | | 17.80 | 1909 | " | Lines West | | |
| | | | | | | | CRUDE | OIL. | | | | | |
| 13.1 | | | | 4 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 14.1 | | | | 57 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 14.2 | | | | 29 | | | | | 1909 | " | Lines West | | |
| 14.3 | | | | 25 | | | | | 1910 | " | Lines East | | |
| 14.4 | | | | 14 | | | | | 1910 | " | Lines West | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—(Continued). | | | | RESULTS. | | | | | | |
| | | | | | MAPLE— | (Hard | ) | —( | *Conti* | *nued* | ). | | | | |
| | | | | | ZI | NC CRE | OS | OT | E—(C | ARD | ). | | | | |
| 11.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 3.1 | | | | | | 5.20 |
| 11.2 | Yes | | " | 85-90 | " | | 1916 | 7.0 | 0.5 | | | | | | 5.20 |
| 11.3 | All | | " | 90 | Gravel | | 1916 | 6.0 | 1.1 | | | | | | 5.20 |
| 11.4 | Yes | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 11.5 | " | | " | 85 | Burnt Clay | | 1916 | 5.0 | 0 | | | Good | | | 5.20 |
| 11.6 | None* | | " | 85 | Burnt Gumbo | Heavy | 1916 | 8.0 | 0 | | | " | | 1 cross-checked; balance good. *In 1916 inside of curve plated with mx plates. Mal. Iron and Sellers 4x8 and 5x8. | 6.11 |
| | | | | | MAPLE—( | Soft). | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 12.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7. | 3.4 | | | | | | 5.20 |
| 12.2 | All | | " | 85-90 | " | | 1916 | 7. | 0 | | | | | | 5.20 |
| 12.3 | " | | " | 90 | Gravel | | 1916 | 6. | 2.0 | | | | | | 5.20 |
| 12.4 | " | | " | 90 | Lyons Stone | | 1916 | 6. | 0 | | | | | | 5.20 |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 13.1 | Yes, except under joints | | Cut | 75 | Gravel | | 1916 | 5.0 | 50.0 | | | | | | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 14.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 96.6 | | | | 4.1 | | 5.20 |
| 14.2 | All | | " | 75-85-90 | " | | 1915 | 6.0 | 100.0 | | | | | | 5.20 |
| 14.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 96.0 | | | | 3.9 | | 5.20 |
| 14.4 | " | | " | 90 | Lyons Stone | | 1915 | 5.0 | 100.0 | | | | | | 5.20 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | MAPLE—( | Soft)—(C | *ontin* | *ued*). | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 15.1 | | | | 75 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 15.2 | | | | 41 | | | | 0.50 | 1909 | " | Lines East | | |
| 15.3 | | | | 50 | | | | 0.50 | 1910 | " | Lines West | | |
| 15.4 | | | | 15 | | | | 0.50 | 1910 | " | Lines East | | |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 16.1 | | | | 383 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 16.2 | | | | 202 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " West | | |
| 16.3 | | | | 75 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " East | | |
| 16.4 | | | | 61 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines West | | |
| 16.5 | 6x8x8 | | | 112 | | | | Zn. 0.50 Cre. 2.00 | 1908 | C.&N.W. | St. Francis, Wis. | | |
| | | | | | | | OAK. | | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | | | Seasoned | 845 | | | Gal. 3.9 | | 1914 | D.L.&W. | Alford, Pa. | | |
| 1.2 | | | | 6 | | | Gal. 3.9 | | 1912 | " | Paterson, N. J. | | |
| | | | | | | | OAK—(Bl | ack). | | | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 2.1 | | | | 106,122 | | | | 0.33 | 1906 | C.&E.I. | Villa Grove, Ill. | | |
| 2.2 | | | | 79,963 | | | | 0.33 | 1907 | " | " " | | |
| 2.3 | | | | 17,547 | | | | 0.33 | 1908 | " | " " | | |
| 2.4 | | | | 869 | | | | 0.33 | 1909 | " | " " | | |
| 2.5 | | | | 5,085 | | | | 0.33 | 1910 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | MAPLE—( | Soft)— | (C | ont | inued | ). | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 15.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Stone | | 1916 | 7.0 | 6.7 | | | | | | 5.20 |
| 15.2 | All | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 9.8 | | | | | | 5.20 |
| 15.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 15.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 16.1 | Partly | | Cut | 75-85-90 | Cin., Gr.,Bt. Cl. | | 1916 | 7.0 | 6.8 | | | | | | 5.20 |
| 16.2 | All | | " | 85-90 | " | | 1916 | 7.0 | 1.0 | | | | | | 5.20 |
| 16.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 16.4 | Partly | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 16.5 | None | | " | 90 | Slag | | 1916 | 8.0 | 0 | | | | | Mechanical wear ⅛ to ⅛. | 48.00 |
| | | | | | OAK. | | | | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | D.L.&W. | | Screw | 105 | Stone | | 1916 | 2.0 | 0 | | | | | | 44.10 |
| 1.2 | " | | " | 101 | " | | 1915 | 3.0 | 0 | | | | | | 44.10 |
| | | | | | OAK—(Black | ). | | | | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 2.1 | | | | | | | 1915 | 9.0 | 9.7 | | | | | | 8.10 |
| 2.2 | | | | | | | 1915 | 8.0 | 4.7 | | | | | | 8.10 |
| 2.3 | | | | | | | 1915 | 7.0 | 2.7 | | | | | | 8.10 |
| 2.4 | | | | | | | 1915 | 6.0 | 37.9 | | | | | | 8.10 |
| 2.5 | | | | | | | 1915 | 5.0 | 0 | | | | | | 8.10 |



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## Cross-Tie Records—Service Tests—(*Continued*).

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Bl | ack)—(C | *ontin* | *ued).* | | | |
| | | | | | ZINC- | TANNI | N—(WELL | HOUSE). | | | | | |
| 3.1 | | | | 149,883 | | | | Zn. 0.50 | 1899-1900 | C.&E.I. | Villa Grove, Ill. | | |
| 3.2 | | | | 26,659 | | | | Zn. 0.50 | 1901 | " | " " " | | |
| 3.3 | | | | 16,925 | | | | Zn. 0.50 | 1902 | " | " " " | | |
| 3.4 | | | | 20,326 | | | | Zn. 0.50 | 1903 | " | " " " | | |
| 3.5 | | | | 27,105 | | | | Zn. 0.50 | 1904 | " | " " " | | |
| 3.6 | | | | 55,000 | | | | Zn. 0.50 | 1905 | " | " " " | | |
| | | | | | | | OAK—(Ch | estnut). | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 4.1 | | | Seasoned 4 mos. | 424 | | | | | 1914 | B.&O. | Medora, Ind. | | |
| | | | | | | | OAK—(Mi | xed). | | | | | |
| | | | | | ZINC- | TANNIN—( | WELLHO | USE). | | | | | |
| 5.1 | 6x8x8 | Hewed | | 3,000 | | 20" | | | 1900 | C.&W.I. | Dalton Branch | Tang. & 3° Curve | 0.5 |
| 5.2 | 6x8x8 | " | | 4,000 | | 20" | | | 1901 | " | " " | Tang. & 3° Curve | 0.5 |
| 5.3 | 6x8x8 | " | | 1,225 | | 20" | | | 1903 | " | " " | Tang. | 0.5 |
| 5.4 | 6x8x8 | " | | 272 | | 20" | | | 1899 | " | " " | Tang. & 3° Curve | 0.5 |
| 5.5 | 6x8x8 | " | | 1,088 | | 20" | | | 1902 | " | " " | Tang. & 3° Curve | 0.5 |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 5.6 | 7x8x8½ | Hewed Sawed | Seasoned | 3,850 | | 18 to 33' | 130-40 | 8-10 | 1910 | Penn. | Wooster, O. | Tang. & 3°-5° Cv. | 0.8 down |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—*(Continued)*. | | RESULTS. | | | | | | | | |
| | | | | | OAK—(Black | )—(*Co* | *nti* | *nue* | *d*). | | | | | | |
| 3.1 | | | | | | | 1915 | 15.0 | 83.7 | | | | | | 8.10 |
| 3.2 | | | | | | | 1915 | 14.0 | 7.3 | | | | | | 8.10 |
| 3.3 | | | | | | | 1915 | 13.0 | 32.3 | | | | | | 8.10 |
| 3.4 | | | | | | | 1915 | 12.0 | 10.6 | | | | | | 8.10 |
| 3.5 | | | | | | | 1915 | 11.0 | 27.5 | | | | | | 8.10 |
| 3.6 | | | | | | | 1915 | 10.0 | 32.1 | | | | | | 8.10 |
| | | | | | OAK—Chestn | ut). | | | | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 4.1 | | | | | | | 1916 | 12.0 | 100.0 | | | | 7.7 | | 4.11 |
| | | | | | OAK—(Mixe | d). | | | | | | | | | |
| | | | | | ZINC-TANNIN | —(WEL | LH | OU | SE). | | | | | | |
| 5.1 | Sellers | 8½x6 | Cut | 80 | Slag | | 1916 | 16.0 | 86.0 | | | Fair | | Only few on curve have plates. | 17.00 |
| 5.2 | " | 8½x6 | " | 80 | " | | 1916 | 15.0 | 86.0 | | | " | | Only few on curve have plates. | 17.00 |
| 5.3 | " | 8½x6 | " | 80 | " | | 1916 | 13.0 | 99.7 | | | " | | | 17.00 |
| 5.4 | " | 8½x6 | " | 80 | " | | 1916 | 17.0 | 79.0 | | | " | | Only few on curve have plates. | 17.00 |
| 5.5 | " | 8½x6 | " | 80 | " | | 1916 | 14.0 | 86.0 | | | " | | Only few on curve have plates. | 17.00 |
| | | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | |
| 5.6 | Flat | 7x9 & 7x13½ | Screw & Cut | 100 | Stone | 14,000,000 | 1916 | 6.0 | 1.6 | | 1.6 | Good | | | 20.11 |

## Cross-Tie Records—Service Tests—(*Continued*).

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | ZINC- | TANNI | OAK—(Black)—(*Contin*<br>N—(WELL | *ued*).<br>HOUSE). | | | | | |
| 3.1 | | | | 149,883 | | | | Zn. 0.50 | 1899-1900 | C.&E.I. | Villa Grove, Ill. | | |
| 3.2 | | | | 26,659 | | | | Zn. 0.50 | 1901 | " | " " " | | |
| 3.3 | | | | 16,925 | | | | Zn. 0.50 | 1902 | " | " " " | | |
| 3.4 | | | | 20,326 | | | | Zn. 0.50 | 1903 | " | " " " | | |
| 3.5 | | | | 27,105 | | | | Zn. 0.50 | 1904 | " | " " " | | |
| 3.6 | | | | 55,000 | | | | Zn. 0.50 | 1905 | " | " " " | | |
| | | | | | | | OAK—(Chestnut). | | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 4.1 | | | Seasoned 4 mos. | 424 | | | | | 1914 | B.&O. | Medora, Ind. | | |
| | | | | | | | OAK—(Mixed). | | | | | | |
| | | | | | ZINC- | | TANNIN—( | WELLHO | USE). | | | | |
| 5.1 | 6x8x8 | Hewed | | 3,000 | | 20" | | | 1900 | C.&W.I. | Dalton Branch | Tang. & 3° Curve | 0.5 |
| 5.2 | 6x8x8 | " | | 4,000 | | 20" | | | 1901 | " | " " | Tang. & 3° Curve | 0.5 |
| 5.3 | 6x8x8 | " | | 1,225 | | 20" | | | 1903 | " | " " | Tang. | 0.5 |
| 5.4 | 6x8x8 | " | | 272 | | 20" | | | 1899 | " | " " | Tang. & 3° Curve | 0.5 |
| 5.5 | 6x8x8 | " | | 1,088 | | 20" | | | 1902 | " | " " | Tang. & 3° Curve | 0.5 |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 5.6 | 7x8x8½ | Hewed Sawed | Seasoned | 3,850 | | 18 to 33' | 130-40 | 8-10 | 1910 | Penn. | Wooster, O. | Tang. & 3°-5° Cv. | 0.8 down |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—*(Continued)*. | | RESULTS. | | | | | | | | |
| | | | | | OAK—(Black | )—(*Co* | *nti* | *nue* | *d*). | | | | | | |
| 3.1 | | | | | | | 1915 | 15.0 | 83.7 | | | | | | 8.10 |
| 3.2 | | | | | | | 1915 | 14.0 | 7.3 | | | | | | 8.10 |
| 3.3 | | | | | | | 1915 | 13.0 | 32.3 | | | | | | 8.10 |
| 3.4 | | | | | | | 1915 | 12.0 | 10.6 | | | | | | 8.10 |
| 3.5 | | | | | | | 1915 | 11.0 | 27.5 | | | | | | 8.10 |
| 3.6 | | | | | | | 1915 | 10.0 | 32.1 | | | | | | 8.10 |
| | | | | | OAK—Chestn | ut). | | | | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 4.1 | | | | | | | 1916 | 12.0 | 100.0 | | | | 7.7 | | 4.11 |
| | | | | | OAK—(Mixe | d). | | | | | | | | | |
| | | | | | ZINC-TANNIN | —(WEL | LH | OU | SE). | | | | | | |
| 5.1 | Sellers | 8½x6 | Cut | 80 | Slag | | 1916 | 16.0 | 86.0 | | | Fair | | Only few on curve have plates. | 17.00 |
| 5.2 | " | 8½x6 | " | 80 | " | | 1916 | 15.0 | 86.0 | | | " | | Only few on curve have plates. | 17.00 |
| 5.3 | " | 8½x6 | " | 80 | " | | 1916 | 13.0 | 99.7 | | | " | | | 17.00 |
| 5.4 | " | 8½x6 | " | 80 | " | | 1916 | 17.0 | 79.0 | | | " | | Only few on curve have plates. | 17.00 |
| 5.5 | " | 8½x6 | " | 80 | " | | 1916 | 14.0 | 86.0 | | | " | | Only few on curve have plates. | 17.00 |
| | | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | |
| 5.6 | Flat | 7x9 & 7x13½ | Screw & Cut | 100 | Stone | 14,000,000 | 1916 | 6.0 | 1.6 | | 1.6 | Good | | | 20.11 |

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## Cross-Tie Records—Service Tests—*(Continued).*

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Pin). | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 6.1 | | | | 164 | | | | 6.17 | 1909 | C.B.&Q. | Lines East | | |
| 6.2 | | | | 24 | | | | 6.17 | 1910 | " | " " | | |
| 6.3 | | | | 3 | | | | 6.17 | 1911 | " | " " | | |
| 6.4 | | | | 87 | | | | 6.17 | 1909 | " | Lines West | | |
| 6.5 | | | | 45 | | | | 6.17 | 1910 | " | " " | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 7.1 | | | | 54 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 7.2 | | | | 24 | | | | | 1910 | " | " " | | |
| 7.3 | | | | 30 | | | | | 1909 | " | Lnes West | | |
| 7.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 8.1 | | | | 15 | | | | 0.50 | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 8.2 | | | | 9 | | | | 0.50 | 1910 | " | Blanding, Ill. | | |
| 8.3 | | | | 45 | | | | 0.50 | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 9.1 | | | | 385 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines East | | |
| 9.2 | | | | 201 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines West | | |
| 9.3 | | | | 126 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines East | | |
| 9.4 | | | | 120 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines West | | |
| | | | | | | | OAK—(Red). | | | | | | |
| | | | | | | | CRESOL-CA | LCIUM. | | | | | |
| 10.1 | | | | 9 | | | | | 1910 | I.C. | Greenville, Miss. | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates Kind | Tie Plates Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l Decay % | Cause R'm'v'l Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | OAK—(Pin). | | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 6.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 6.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 6.3 | Yes | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 6.4 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 6.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 7.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 87.0 | | | | | | 5.20 |
| 7.2 | Yes | | " | 90 | Gravel | | 1916 | 6.0 | 37.5 | | | | | | 5.20 |
| 7.3 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 86.7 | | | | | | 5.20 |
| 7.4 | " | | " | 85-90 | Lyons Stone | | 1916 | 6.0 | 40.0 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 8.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 8.2 | Yes | | " | 90 | " | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 8.3 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 9.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Stone | | 1916 | 7.0 | 1.3 | | | | | | 5.20 |
| 9.2 | All | | " | 85-90 | " | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 9.3 | " | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 9.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | OAK—(Red). | | | | | | | | | | |
| | | | | | | CRESOL | —C | AL | CIU | M. | | | | | |
| 10.1 | | | | | | | 1916 | 6.0 | 100.0 | 100.0 | | | 4.0 | | 12.11 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | | CREO | SOTE. | | | | | |
| 11.1 | 7x9x8½ | Sawed Hewed | Peeled Seasoned | 872 | | | Gal. 2.5 | | 1911 | B.&O. | Windsor, O. | | |
| 11.2 | 6x8x8 | Hewed | | 4,070 | | | | | 1914 | Q.&C. | Cincinnati, O. | | |
| 11.3 | 7x9x8½ | " | | 3,200 | | | 32.36 | 8.70 | 1914 | " | Williamstown, Ky. | | |
| 11.4 | | | | 8 | | | | | 1905 | St.L.& S.F. | Pacific, Mo. | | |
| 11.5 | 8x7x9 | Sawed | Seasoned | 68 | Ala. | | | 5.54 | 1910 | T.C.I. &R. | Ensley, Ala. | | |
| | | | | | | CREO | SOTE—(BE | THELL). | | | | | |
| 12.1 | 6x8x8 | Sawed Hewed | Varied | 76 | | | 6-42 | | 1905 | St.L.& S.F. | Pacific, Mo. | Tang. | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 13.1 | | | | 60 | | | | 8.34 | 1910 | C.B.&Q. | Lines West | | |
| 13.2 | | | | 60 | | | | 8.34 | 1909 | " | " " | | |
| 13.3 | | | | 97 | | | | 8.34 | 1908 | " | Lines East | | |
| 13.4 | | | | 108 | | | | 8.34 | 1909 | " | " " | | |
| 13.5 | | | | 55 | | | | 8.34 | 1910 | " | " " | | |
| 13.6 | | | | 25 | | | | 8.34 | 1911 | " | " " | | |
| 13.7 | 6x8x8 | Hewed | Seasoned | 50 | | 18 to Rl. | | 10.90 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| 13.8 | 6x8x8 | " | " | 52 | | 18 to Rl. | 53.6 | 10.90 | 1911 | " | " " | " | 0 |
| 13.9 | 7x9x8½ | | | 50 | | | | 17.40 | 1910 | Q.&C. | Birmingham, Ala. | | |
| 13.10 | 7x9x8½ | Sawed Hewed | Air-seasoned 9 mos. | 188 | Ky. & Tenn. | 17 to Rl. | | 14.33 | 1915 | L.&N. | Memphis, Tenn. | " | .42 to 0.8 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | | | CR | EOS | OTE. | | | | | | |
| 11.1 | Shoulder Flange | | Cut | 90 | Gravel | 10,586,000 | 1916 | 5.0 | 0 | | | 99.9% Good | | | 4.11 |
| 11.2 | | | | | | | 1916 | 2.0 | 0 | | | Sound | | Under track in street paved with granite blocks—Set in concrete. | 47.00 |
| 11.3 | Economy | 7x8½x½ | Screw | 85 | " | | 1916 | 2.0 | 0 | | | " | | | 47.00 |
| 11.4 | | | | | | | 1916 | 11.0 | 25.0 | | | | | Incomplete record. | 30.20 |
| 11.5 | Goldie | | Cut | | Sand & Dirt | | 1915 | 5.5 | 25.0 | 25.0 | | 23.5% Good | | 51.5% decayed and partly decayed. Tie-plates on curves only. | 21.00 |
| | | | | | | CREOSO | TE | —(B | ETHE | LL). | | | | | |
| 12.1 | ½" Rib. | 8½x6½ | Cut | 85 | Gravel | 9,000,000 | 1916 | 11.0 | 10.5 | | | | | Includes red gum. Gravel put in on cinders in 1914. Tie-plates since 1914. | 30.20 |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 13.1 | Yes | | Cut | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 13.2 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 13.3 | Partly | | " | 90 | Gravel | | 1916 | 8.0 | 0 | | | | | Tie-plates on curves | 5.20 |
| 13.4 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0.9 | | | | | | 5.20 |
| 13.5 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 13.6 | Yes | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 13.7 | Economy | 7½x9 | Screw | 90 | " | Heavy | 1916 | 5.0 | 0 | | | 96.1% Good | | 3.9% partly split. | 27.00 |
| 13.8 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 96.1% Good | | 3.9% " " | 27.00 |
| 13.9 | Rolled St. | 7x8½x½ | " | 85 | Slag | | 1915 | 5.0 | 0 | | | Sound | | | 47.00 |
| 13.10 | None | | " | 90 | Gr. filled stone | 6,255,084 | 1916 | 1.0 | 0 | | | Excellent | | Includes other hardwoods. Expected ave. life 14 years. | 18.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption: Lbs. Per Tie | Average Absorption: Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | CR | EOSOTE—( | GIUSSANI | ). | | | | |
| | | | | | | (See | Gum Index | No. 5.1). | | | | | |
| 14.1 | 6x8x8 | Sawed Hewed | Varied | 43 | | | Zn. 0.75-1.0 Cre. 10-15 | | 1905 | St.L.& S.F. | Pacific, Mo. | | |
| | | | | CR | EOSO | TE—(L | IVE STEAM | IN SUPE | HEAT | ED COI | LS). | | |
| 15.1 | 6x8x8 | Sawed Hewed | | 24 | | | 6-42 | | 1905 | St.L.& S.F. | Pacific, Mo. | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 16.1 | 6x8x8 | Sawed | Seasoned | 199 | Ind. | 20″ | 20.60 | 7.70 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| 16.2 | 6x8x8 | Hewed | " | 198 | " | 20″ | 20.60 | 7.70 | 1914 | " | " " | " | 0.5 |
| 16.3 | 6x8x8 | " | " | 264 | | 18″ | 21.75 | 8.18 | 1910 | N.Y.C. | Cleveland, O. | " | |
| 16.4 | 6x8x8 | " | " | 100 | Mid. So. States | 20″ | 21.75 | 8.18 | 1910 | " | West Park, O. | " | |
| 16.5 | 6x8x8 | Sawed Hewed | " | 1,981 | " | 18″ | 21.75 | 8.18 | 1910 | " | Cleveland, O. | " | |
| 16.6 | 6x8x8 | Sawed | " | 242 | " | 18″ | 21.75 | 8.18 | 1910 | " | Elyria, O. | " | |
| 16.7 | 6x8x8 | Hewed | " | 100 | " | 20″ | 21.75 | 8.18 | 1910 | " | Cleveland, O. | " | |
| 16.8 | 6x8x8 | " | " | 85 | " | 20″ | 21.75 | 8.18 | 1910 | " | " | Cv. 3° 34′ | |
| 16.9 | 6x8x8 | " | " | 130 | " | 20″ | 21.75 | 8.18 | 1910 | " | West Park, O. | Tang. | |
| 16.10 | 6x8x8 | " | " | 111 | " | 20″ | 21.75 | 8.18 | 1910 | " | " | " | |
| 16.11 | 6x8x8 | Sawed | " | 66 | " | 18″ | 21.75 | 8.18 | 1910 | " | Elyria, O. | Cv. 6° 20′ | |
| 16.12 | 6x8x8 | | " | 970 | " | 20″ | 21.75 | 8.18 | 1910 | " | Cleveland, O. | Tang. | |
| 16.13 | 6x8x8 | Hewed | " | 1,160 | " | 22″ | 21.75 | 8.18 | 1910 | " | North Storage, O. | " | 0 |

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| Service Conditions—(*Continued*). | | | | | | Results. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | CREOSOTE—( | GIUSSA | NI). | | | | | | | | |
| | | | | | (See Gum Index | No. 5.1). | | | | | | | | | |
| 14.1 | ½" Rib | 8¾x6½ | Cut | 85 | Gravel | 9,000,000 | 1916 | 11.0 | 41.9 | | | | | Includes red gum and beech. | 30.20 |
| | | | | CRE | OSOTE—(LIVE | ST EAM | IN | SUP | ERH | EAT | ED | COILS). | | | |
| 15.1 | " | 8¾x6½ | Cut | 85 | Gravel | 9,000,000 | 1916 | 11.0 | 8.3 | | | | | Includes red gum. | 30.20 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 16.1 | Economy | 7 | Cut | 90 | Gravel | 5,297,567 | 1916 | 2.0 | 0 | | | Excellent | | Treated July 1913 and set June, 1914. | 51.00 |
| 16.2 | " | 7 | " | 90 | " | 5,297,567 | 1916 | 2.0 | 0 | | | Excellent | | Treated July 1913 and set June, 1914. | 51.00 |
| 16.3 | None | | " | 80 | Gravel & Cinders | | 1916 | 6.0 | 0 | | | Good | | Includes beech and maple. | 14.10 |
| 16.4 | " | | " | 80 | Stone | | 1916 | 6.0 | 20. | | | " | | Includes beech and maple. Removed because burned. | 14.10 |
| 16.5 | | | " | 80 | Cinders | | 1916 | 6.0 | 1.5 | | | " | | Includes beech and maple. Removed because of Subway. | 14.10 |
| 16.6 | " | | " | 80 | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.7 | " | | " | 100 | Sand | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.8 | " | | " | 100 | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.9 | " | | " | 100 | Stone | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.10 | " | | " | 100 | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.11 | Shoulder | ¼x7x8¾ | " | 80 | Cinder | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.12 | None | | " | 80 | Slag | | 1916 | 6.0 | 10.3 | | | | | Includes beech and maple. Removed because of track changes. | 14.10 |
| 16.13 | " | | " | 100 | Gravel | | 1916 | 6.0 | 0 | | | Very Good | | Includes beech and maple. These ties will last 8 to 10 years more. | 14.10 |

Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | | CREOSOTE | —(LOWRY | ). | | | | |
| 16.14 | 6x8x8 | Hewed | Seasoned | 1,184 | Mid. So. States | 22" | 21.75 | 8.18 | 1910 | N.Y.C. | Amherst, O. | " | 0 |
| 16.15 | 6x8x8 | " | " | 633 | " | 22" | 21.75 | 8.18 | 1910 | " | Boy Bridge, O. | " | 0 |
| 16.16 | 6x8x8 | " | " | 1,203 | " | 22" | 21.75 | 8.18 | 1910 | " | Venice, O. | Curve | 0 |
| 16.17 | 6x8x8 | " | " | 494 | " | 22" | 21.75 | 8.18 | 1910 | " | Sandusky, O. | Tang. | 0 |
| 16.18 | 6x8x8 | " | " | 3,287 | " | 22" | 21.75 | 8.18 | 1910 | " | Danbury, O. | " | 0 |
| 16.19 | 6x8x8 | Sawed Hewed | " | 224 | " | 18" | 21.75 | 8.18 | 1910 | " | Cleveland, O. | " | |
| 16.20 | 6x8x8 | Sawed Hewed | " | 1,086 | " | 20" | 21.75 | 8.18 | 1910 | " | " | " | |
| 16.21 | 6x8x8 | Sawed Hewed | " | 6,000 | " | 18" | 21.75 | 8.18 | 1910 | " | Swanton, O. | " | |
| 16.22 | 6x8x8 | Sawed | " | 292 | " | 18" | 21.75 | 8.18 | 1910 | " | Elyria, O. | Cv. 6° 20' | |
| 16.23 | 6x8x8 | Hewed | " | 7,488 | " | 20¼" | 21.75 | 8.18 | 1910 | " | Mentor, O. | Tang. | |
| 16.24 | 6x8x8 | Sawed | " | 741 | " | 20" | 21.75 | 8.18 | 1910 | " | Erie, Pa. | " | |
| 16.25 | 6x8x8 | Hewed Sawed | " | 6,000 | " | 20" | 21.75 | 8.18 | 1910 | " | Ekhart, Ind. | " | |
| 16.26 | 6x8x8 | Sawed | " | 2,997 | " | 20" | 21.75 | 8.18 | 1910 | " | Lake View, N. Y. | " | 0.3 |
| 16.27 | 6x8x8 | " | " | 1,038 | " | 20" | 21.75 | 8.18 | 1910 | " | Silver Crk., N.Y. | Cv. & Tang. | various |
| 16.28 | 6x8x8 | " | " | 1,512 | " | 20" | 21.75 | 8.18 | 1910 | " | Ripley, N. Y. | Tang. | 0.3 |
| 16.29 | 7x9x8 | Hewed | " | 46 | Minn. | 19 to Rl | 22.80 | 6.50 | 1908 | N.P. | Sumner, Wash. | " | 0 |

| Index No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | CREOSOTE—( | LOWRY | ). | | | | | | | | |
| 16.14 | None | | Cut | 80 | Gravel | | 1916 | 6.0 | 0 | | | Very Good | | Includes beech and maple. These ties will last 8 to 10 years more. | 14.10 |
| 16.15 | " | | " | 80 | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. These ties will last 8 to 10 years more. | 14.10 |
| 16.16 | " | | " | | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. These ties will last 8 to 10 years more. | 14.10 |
| 16.17 | " | | " | 80 | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. These ties will last 8 to 10 years more. | 14.10 |
| 16.18 | " | | " | 100 | " | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. These ties will last 8 to 10 years more. | 14.10 |
| 16.19 | " | | " | 80 | Stone & Cinders | | 1916 | 6.0 | 0 | | | Good | | Includes beech and maple. | 14.10 |
| 16.20 | " | | | 80 | Slag | | 1916 | 6.0 | 4.8 | | | " | | Removed acct. wreck. | 14.10 |
| 16.21 | " | | " | 80 | Gravel | | 1916 | 6.0 | 0.7 | | | " | | Includes beech and maple. | 14.10 |
| 16.22 | Flange | ½x4½x6 | " | 80 | Cinders | | 1916 | 6.0 | | | | | | | |
| 16.23 | None | | " | 80 | Stone Since 1915 | | 1916 | 6.0 | 0.1 | | | | | Removed acct. adzing and track heaving. 2 ties decayed, 5 sp. killed | |
| 16.24 | | | " | 80 | Stone | | 1916 | 6.0 | 0.4 | | 0.4 | " | | Includes beech and maple. | 14.10 |
| 16.25 | Flange | ½x6x8 | " | 65 | Gravel | | 1916 | 6.0 | 0 | | | " | | Includes beech and maple. | 14.10 |
| 16.26 | | | " | 80 | Stone | | 1916 | 6.0 | 0.1 | | 0.1 | " | | " " " " | 14.10 |
| 16.27 | Single Flange | 6x8 | " | 100 | " | | 1916 | 6.0 | 0.8 | 0.2 | 0.1 | " | | Includes beech and maple 0.5% removed account wreck. | 14.10 |
| 16.28 | | | " | 100 | " | | 1916 | 6.0 | 0.4 | | 0.3 | " | | Includes beech and maple. 0.1% burned. | 14.10 |
| 16.29 | Flat 4 ridges | 6x8½x 9/16 | " | 85 | Gravel | Heavy | 1916 | 7.0 | 0 | | | O. K. | | | 19.00 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | CREOS | OTE—(NO | STEAM). | | | | | |
| 17.1 | | | Seasoned 12 mos. | 200 | La. | | | 7.00 | 1910 | St.L.& S.W. | Texas | | |
| 17.2 | | | Seasoned | 200 | Texas | | | 8.00 | 1911 | " | Texarkana, Tex. | | |
| 17.3 | | Sawed Hewed | Varied | 83 | | | 11-30. | | 1905 | St.L.& S.F. | Pacific, Mo. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 18.1 | | Sawed | Seasoned | 52 | | | | 5.00 | 1907 | A.T.& S.F. | Plevna, Kan. | | |
| 18.2 | | | | 15 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| 18.3 | 6x8x8 | Hewed | " | 50 | | 18 to Rl. | | 5.30 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0. |
| 18.4 | 6x8x8 | " | " | 50 | | 18 to Rl. | | 5.30 | 1911 | " | " " | " | 0. |
| 18.5 | 6x8x8 | " | " | 274 | | | | 5.00 | 1910 | I.C. | Bloomington, Ill. | | |
| 18.6 | 6x8x8 | Sawed Hewed | " | 274 | | | | 5.00 | 1909 | " | Fulton, Ky. | | |
| 18.7 | 6x8x8 | Hewed | " | 274 | | | | 5.00 | 1910 | " | Greenville, Miss. | | |
| 18.8 | 6x8x8 | Sawed Hewed | " | 274 | | | | 5.00 | 1909 | " | Kankakee, Ill. | | |
| 18.9 | 6x8x8 | Hewed | Seasoned 2 years | 752 | | | 12.6 | | 1906 | St.L.& S.F. | St. Clair, Mo. | | |
| 18.10 | 6x8x8 | Sawed Hewed | Varied | 40 | | | 7-21.5 | | 1905 | " | Pacific, Mo. | Tang. | |
| 18.11 | 7x8x8½ | Sawed Hewed | Seasoned | 3,789 | | 18 to 33' | 22.5 | 6.80 | 1907 | Penn. | Scio, O | 1.5° Cv. & Tang. | 0.1 |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 19.1 | | | | 3 | | | | | 1911 | C.B.&Q. | Baders. Ill. | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—*(Continued)*. | | RESULTS. | | | | | | | | |
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | CR | EOSOTE | —( | NO | STEA | M). | | | | | |
| 17.1 | | | | | | | 1916 | 6.0 | 0 | | | Good | | Seasoned 10 mos. after treatment, 7% checked, rail-cut and split. | 35.00 |
| 17.2 | | | | | | | 1916 | 6.0 | 0 | | | " | | 8.5% are checked. | 35.00 |
| 17.3 | ½" Rib | 8½x6½ | Cut | 85 | Gravel | 9,000,000 | 1916 | 11.0 | 13.3 | | | | | Includes red gum. | 30.20 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 18.1 | | 7½x9 | Cut | 90 | Rock | 4,904,161 | 1916 | 9.0 | 0 | | | | | | 45.10 |
| 18.2 | Yes | | | 75 | Gravel | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 18.3 | Flat St. | 6x8 | Screw | 90 | " | Heavy | 1916 | 5.0 | 0 | | | 95% Good | | 5% partly split. | 27.00 |
| 18.4 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 95% Good | | 5% partly split. | 27.00 |
| 18.5 | Sellers | 6x8 | " | 75 | " | | 1916 | 6.0 | 0 | | | 95% Good | | 50% tie-plated. | 12.11 |
| 18.6 | | 6x8 | " | 90 | " | | 1916 | 7.0 | 5.5 | | 5.5 | | | Ties worn out and split acct. badly creeping track. | 12.11 |
| 18.7 | Economy | 6x8 | " | 75 | Gravel Since 1912 | | 1916 | 6.0 | 0.7 | | 0.7 | | | | 12.11 |
| 18.8 | " | 6x8 | " | 90 | Stone | | 1916 | 7.0 | 9.1 | | | | | Removed account derailment: 50% tie-plated. | 12.11 |
| 18.9 | ½" Rib | 8½x6½ | " | 85 | Chats | 8.300,000 | 1916 | 10.0 | 0.1 | | | | | Chats Ballast put in on gravel in 1913. Rails changed from 75 to 85 in 1909. Tie plates since 1914. | 30.20 |
| 18.10 | " | 8½x6½ | " | 85 | Gravel | 9,000,000 | 1916 | 11.0 | 10.0 | | | | | Includes red gum, gravel put in cinders in 1914. Tie-plates since 1914. | 30.20 |
| 18.11 | Flat | 6x9 | C. & S. | 100 | Stone | | 1916 | 9.0 | 49.0 | | 49.0 | Sound | | | 20.11 |
| | | | | | CR | EOSOTE | AN | D C | RUD | E OI | L. | | | | |
| 19.1 | | | Cut | 75 | Gravel | | 1916 | 5.0 | 0 | | | | | | 5.20 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing in Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | | CRUDE | OIL. | | | | | |
| 20.1 | | | | 3 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | DIAM | OND WOOD | PRESERV | ER. | | | | |
| 20.2 | 7x9x8 | Hewed | | 500 | | | | Gal. 0.15 | 1907 | G.H& S.A. | El Paso | | |
| | | | | | | FU | EL OIL—( | LOW-PRE | SSUR | E). | | | |
| 21.1 | | " | Seasoned | 331 | | | Gal. 3.05 | 8.70 | 1910 | Picatinny Arsenal | Dover, N. J. | | |
| | | | | | | | J. M. LONG'S | LIQUID. | | | | | |
| 22.1 | | | " | 50 | | | | 0.135 | 1910 | I.C. | Greenville, Miss. | | |
| | | | S | EMI R | EFIN | ED OI | L—PARAFF | IN BASE— | (FUL | L-CELL | ). | | |
| 23.1 | 6x8x8 | | " | 50 | " | 18 to Rl. | | 7.30 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| 23.2 | 6x8x8 | | " | 50 | | 18 to Rl. | | 7.30 | 1911 | " | " " | | 0 |
| | | | | | TAR | (20%) | AND CREO | SOTE (80 | %)—( | LOWRY). | | | |
| 24.1 | | Hewed | Seasoned 14 mos. | 1,865 | Ark. | | 7.58 | 2.52 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 24.2 | | Sawed | " | 955 | " | | 7.58 | 2.52 | 1912 | " | " | | |
| | | | | | | | TIMBER- | ASHPALT | . | | | | |
| 25.1 | 7x9x8½ | Hewed Sawed | Peeled Seasoned | 1,011 | | | Gal.1.75-5.42 | | 1911 | B.&O. | Windsor, O. | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | | CR | U | DE | OIL. | | | | | | |
| 20.1 | | | Cut | 75 | Gravel | | 1916 | 5.0 | 0 | | | | | | 5.20 |
| | | | | | DIA | MOND | WO | OD | PRES | ERV | ER. | | | | |
| 20.2 | Glendon | | " | | Slag | | 1916 | 9.5 | 3.4 | | | Good | | | 7.10 |
| | | | | | FUEL | OIL—(L | OW- | PR | ESSU | RE). | | | | | |
| 21.1 | Flat & Flange | | | | | | 1915 | 5.0 | 0 | | | | | | 22.00 |
| | | | | | | J. M. | LO | NG' | S LIQ | UID. | | | | | |
| 22.1 | Economy | | | 75 | Dirt | | 1916 | 6.0 | 100.0 | 100.0 | | | 4.75 | 50% tie-plated. | 12.11 |
| | | | SEMI- | | REFINED OIL | —PARA | FFI | N | IN BA | SE— | (FU | LL-CELL). | | | |
| 23.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 99% Good | | 1% partly split. | 27.00 |
| 23.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 99% Good | | 1% " " | 27.00 |
| | | | | | TAR, (20%) | AND CR | EO | SOT | E, (80 | %)— | (LO | WRY). | | | |
| 24.1 | | | | | | | 1916 | 4.0 | 0 | | | | | Ave. sapwood, 8%. | 8.10 |
| 24.2 | | | | | | | 1916 | 4.0 | 0 | | | | | " " 8%. | 8.10 |
| | | | | | | TIMB | ER- | ASP | HAL | T. | | | | | |
| 25.1 | Shoulder Flange | | Cut | 90 | Gravel | 10,586,000 | 1916 | 5.0 | 0 | | | 98.7% Good | | 1.3% are decayed. | 4.11 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 26.1 | | | | 15 | | | | | 1910 | C.B.&Q. | Lines West | | |
| 26.2 | 6x8x8 | | Seasoned 10 mos. | 50 | Tenn. | 18 to Rl. | | | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0. |
| 26.3 | 6x8x8 | | " | 50 | " | 18 to Rl. | | | 1911 | " | " " | " | 0. |
| 26.4 | | | | 50 | | | | | 1908 | C.B.&Q. | Lines East | | |
| 26.5 | | | | 108 | | | | | 1909 | " | " " | | |
| 26.6 | | | | 25 | | | | | 1910 | " | " " | | |
| 26.7 | | | | 59 | | | | | 1909 | " | Lines West | | |
| 26.8 | 7x8x8½ | | | 1,900 | | 18 to 33' | | | 1907 | Penn. | Scio., O. | 2° Curve & Tang. | 0.1 |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 27.1 | 6x8x8 | Hewed | | 97,920 | Ill. (Generally) | 18 to Rl. | | 0.50 | 1907 | C.&A. | Iles, Ill. | 34 mile Tang. | 0.3(max.) |
| 27.2 | | | | 109 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 27.3 | | | | 47 | | | | 0.50 | 1910 | " | " " | | |
| 27.4 | | | | 20 | | | | 0.50 | 1911 | " | " " | | |
| 27.5 | | | | 60 | | | | 0.50 | 1910 | " | Lines West | | |
| 27.6 | | | | 56 | | | | 0.50 | 1909 | " | " " | | |
| 27.7 | | | | 550 | | | | 0.33 | 1900 | " | Mystic, S. D. | 12° Cv. & Tang. | 0.3 |
| 27.8 | 6x8x8 | Sawed Hewed | | 274 | | | | 0.50 | 1909 | I.C. | Kankakee, Ill. | | |
| 27.9 | 6x8x8 | Sawed Hewed | | 274 | | | | 0.50 | 1909 | " | Fulton, Ky. | | |
| 27.10 | 6x8x8 | Sawed Hewed | | 274 | | | | 0.50 | 1910 | " | Greenville, Miss. | | |
| 27.11 | 6x8x8 | Sawed Hewed | Seasoned | 274 | | | | 0.50 | 1910 | " | Bloomington, Ill. | | |
| 27.12 | 6x8x8 | Hewed | Steamed Seasoned | 176 | | 18 to Rl. | 1.50 | 0.50 | 1911 | C.M.& St.P. | Madison, Wis. | Tang. | 0 |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 26.1 | Yes | | Cut | 90 | Lyons Stone | | 1916 | 6.0 | 40.0 | | | | | | 5.20 |
| 26.2 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 2.0 | 2.0 | | 38% Good | | 57% partly decayed. 3% partly split. | 27.00 |
| 26.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 2.0 | 2.0 | | 38% Good | | 3% partly split. Tie-plates on curves only. | 27.00 |
| 26.4 | Yes | | " | 90 | " | | 1916 | 8.0 | 92.0 | | | | | | 5.20 |
| 26.5 | Partly | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 94.5 | | | | | | 5.20 |
| 26.6 | Yes | | " | 90 | Gravel | | 1916 | 6.0 | 80.0 | | | | 5.0 | | 5.20 |
| 26.7 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1915 | 6.0 | 100.0 | | | | | | |
| 26.8 | Flat | 6x9 | " | 100 | Stone | | 1914 | 7.0 | 100.0 | | | | 5.75 | All out in 7 years. | 20.11 |
| | | | | | ZINC CHLORI | DE—(B | UR | NE | TT). | | | | | | |
| 27.1 | Few | | Cut | 80 | Gr. and Cinders | | 1916 | 9.0 | 21.0 | 21.0 | | Fair | | | 50.00 |
| 27.2 | Partly | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 7.3 | | | | | | 5.20 |
| 27.3 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 27.4 | Yes | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 27.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 1.7 | | | | | | 5.20 |
| 27.6 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 27.7 | " | | " | 75 | Lime Stone & Blk. Hills Dirt | | 1916 | 16.0 | 23.1 | 22.5 | | | | Outside rail on curves changed 1909. 0.6% removed for experimental purposes. | 5.20 |
| 27.8 | Sellers | 6x8 | " | 90 | Stone | | 1916 | 7.0 | 24.8 | | | | | 50% tie-plated. Removed acct. derailment. | 12.11 |
| 27.9 | " | 6x8 | " | 90 | Gravel | | 1916 | 7.0 | 69.3 | | 69.3 | | | Removed acct. split and wear. | 12.11 |
| 27.10 | " | 6x8 | " | 75 | Gr. Since 1912 | | 1916 | 6.0 | 14.2 | | 14.2 | | | 50% tie-plated. Ties checked and spike worn. | 12.11 |
| 27.11 | " | 6x8 | " | 75 | Gravel | | 1916 | 6.0 | 0 | | | | | 50% tie-plated. | 12.11 |
| 27.12 | None | | " | 75 | " | Average | 1916 | 5.0 | 9.1 | | | 13.6% badly rail-cut | | Few are slightly rotten and split. All rail-cut ¼ to ½ in. | 6.11 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| 27.13 | 6x8x8 | | Seasoned | 50 | | 18 to Rl. | | 0.50 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| 27.14 | 6x8x8 | | " | 50 | | 18 to Rl. | | 0.50 | 1911 | " | " " | " | 0 |
| 27.15 | 6x8x8 | | " | 208 | | 18 to Rl. | | 0.50 | 1911 | " | " " | " | 0 |
| 27.16 | 6x8x8 | | " | 52 | | 18 to Rl. | | 0.50 | 1911 | " | " " | " | 0 |
| 27.17 | 6x8x8 | Hewed | Steamed Seasoned | 300 | | 22" | 1.50 | 0.50 | 1907 | C.M.& St.P. | McLaughlin, S. D. | Tang. | 0.1 |
| 27.18 | 6x8x8 | " | Seasoned | 373 | Mo. | 19 to Rl. | | 0.50 | 1913 | " | Byron, Ill. | " | 0 |
| 27.19 | 6x8x8 | " | Steamed Unseasoned | 432 | " | 19 to Rl. | | 0.50 | 1913 | " | " | " | 0 |
| 27.20 | 6x8x8 | Sawed | Seasoned 12 mos. | 672 | Ky. | | 1.453 | 0.539 | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 27.21 | 6x8x8 | Hewed | " | 769 | " | | 1.453 | 0.539 | 1912 | " | " " | | |
| 27.22 | 6x8x8 | Sawed | " | 724 | " | | 0.919 | 0.346 | 1912 | " | " " | | |
| 27.23 | 6x8x8 | Hewed | " | 621 | " | | 0.919 | 0.346 | 1912 | " | " " | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| 27.13 | Economy | 7½x9 | Screw | 90 | " | Heavy | 1916 | 5.0 | 0 | | | 95% Good | | 5% partly split. | 27.00 |
| 27.14 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 95% Good | | 5% " " | 27.00 |
| 27.15 | Economy | 7½x9 | Screw | 90 | " | " | 1916 | 5.0 | 0 | | | 97.5% Good | | 1½% partly decayed. 1% partly split. | 27.00 |
| 27.16 | M.I.Rib. | 6x8 | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 97.5% Good | | 1½% partly decayed. 1% partly split. | 27.00 |
| 27.17 | None | | Cut | 85 | Gravel | 5,562,600 | 1916 | 9.0 | 10.0 | 10.0 | | | | 90 lb. rail placed in 1916. None removed until 1913. | 6.11 |
| 27.18 | " | | " | 100 | " | Heavy | 1916 | 3.0 | 0 | | | Good | | Many of these ties much smaller. Should have been called No. 2. | 6.11 |
| 27.19 | " | | | 100 | " | " | 1916 | 3.0 | 0 | | | Good | | Many of these ties much smaller. Should have been called No. 2. | 6.11 |
| 27.20 | | | | | | | 1916 | 4.0 | 0 | | | | | No steaming. Avg. sapwood 10%. Treated ties stacked in open piles 24 days before setting. Are an open grain variety of oak. | 8.10 |
| 27.21 | | | | | | | 1916 | 4.0 | 0 | | | | | No steaming. Avg. sapwood 10%. Treated ties stacked in open piles 24 days before setting. Are an open grain variety of oak. | 8.10 |
| 27.22 | | | | | | | 1916 | 4.0 | 0 | | | | | Avg. sapwood 20%. Treated ties stacked in open piles 24 days before setting. No steaming. | 8.10 |
| 27.23 | | | | | | | 1916 | 4.0 | 0 | | | | | Avg. sapwood 20%. Treated ties stacked in open piles 24 days before setting. No steaming. | 8.10 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(Re | d)—(*Con* | *tinued* | ). | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 27.24 | 7x9x8½ | Sawed Hewed | Seasoned 9 mos. | 237 | Ky. & Tenn. | 17 to Rl. | 1.776 | 0.48 | 1915 | L.&N. | Memphis, Tenn. | Tang. | .42 to .8 |
| | | | | | | ZINC | CREOSOTE | —(CARD). | | | | | |
| 28.1 | | | | 545 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 28.2 | | | | 102 | | | | Zn. 0.50 Cre. 3.00 | 1908 | " | " " | | |
| 28.3 | | | | 220 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 28.4 | | | | 110 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | " " | | |
| 28.5 | | | | 292 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 28.6 | | | | 211 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 28.7 | 7x9x8½ | Sawed Hewed | Peeled Seasoned | 1,237 | | | | Zn. 0.50 Cre. 2.00 | 1911 | B.&O. | Windsor, O. | | |
| 28.8 | 6x8x8 | | Seasoned | 50 | | 18 to Rl. | | Zn. 0.37 Cre. 3.06 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| 28.9 | 6x8x8 | | " | 50 | | 18 to Rl. | | Zn. 0.37 Cre. 3.06 | 1911 | " | " " | " | 0 |
| | | | | | ZINC- | CREO | SOTE (*TW | O MOVE | MEN | T). | | | |
| 29.1 | 6x8x8 | Hewed | Seasoned | 50 | | 18 to Rl. | | Emulsion 15.3 | 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| 29.2 | 6x8x8 | " | " | 50 | | 18 to Rl. | | Emulsion 15.3 | 1911 | " | " " | " | 0 |
| | | | | | | | ZINC-CREO | SOTE. | | | | | |
| 30.1 | 7x8x8 | " | " | 250 | | | | Zn. 4% C. 12% | 1906 | G.H.& S.A. | Louisiana | | |

*Special Treatment.

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | OAK—(Red) | —(*Cont* | *inu* | *ed* | ). | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 27.24 | None | | Cut | 90 | | | 1916 | 4.0 | 0 | | | Excellent | | Includes other hardwoods. Ave. life, 11 years expected. | 18.00 |
| | | | | | ZI | NC CRE | OS | OT | E—(C | ARD | ). | | | | |
| 28.1 | Partly | | Cut | 75-85-90 | Cin., Gr. Bt. Cl. | | 1916 | 7.0 | 4.4 | | | | | | 5.20 |
| 28.2 | " | | " | 90 | Gravel | | 1916 | 8.0 | 1.0 | | | | | Tie-plates on curves. | 5.20 |
| 28.3 | All | | " | 90 | " | | 1916 | 6.0 | 0.5 | | | | | | 5.20 |
| 28.4 | Yes | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 28.5 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0.3 | | | | | | 5.20 |
| 28.6 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 28.7 | Shoulder Flange | | " | 90 | Gravel | 10,586,000 | 1916 | 5.7 | 0 | | | 99.4% Good | | 0.6% decayed. | 4.11 |
| 28.8 | None | | " | 90 | " | Heavy | 1916 | 5.0 | 0 | | | 92% Good | | 8% partly split. | 27.00 |
| 28.9 | " | | " | 90 | " | " | 1916 | 5.0 | 0 | | | 92% Good | | 8% partly split. | 27.00 |
| | | | | | ZINC- | CREOSO | TE | —(* | TWO | MOV | EME | NT). | | | |
| 29.1 | Economy | 7½x9 | Screw | 90 | Gravel | Heavy | 1916 | 5.0 | 0 | | | 95% Good | | 3% Zinc Chloride Solution and Creosote. 5% partly split. | 27.00 |
| 29.2 | None | | Cut | 90 | " | " | 1916 | 5.0 | 0 | | | 95% Good | | 5% partly split. | 27.00 |
| | | | | | | ZINC- | CRE | OS | OTE. | | | | | | |
| 30.1 | I. & W. | | Cut | 80 | Gravel | | 1916 | 10.0 | 42.8 | | | | | | 7.10 |

*Special treatment.



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OAK—(White). | | | | | | |
| | | | | | | | CREOSOTE. | | | | | | |
| 31.1 | | | | 15 | | | | | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 31.2 | | | | 10 | | | | | 1910 | " | Blanding, Ill. | | |
| 31.3 | | | | 15 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 32.1 | 7x9x8.5 | Hewed | | 50 | | 20" | | | 1910 | Q.&C. | Birmingham | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 33.1 | 6x8x8 | " | Seasoned | 131 | Ind. | 20" | 22.2 | 8.3 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| 34.1 | | | Seasoned 11 mos. | 200 | Ark. | | | 8.0 | 1910 | St.L.& S.W. | Texarkana, Tex. | | |
| | | | | | | | UNTREATED. | | | | | | |
| 35.1 | | Hewed | | 1,470 | Mo. | | | | 1912 | C.&E.I. | Tuscola, Ill. | | |
| 35.2 | | | | 56 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 35.3 | | | | 25 | | | | | 1910 | " | " " | | |
| 35.4 | | | | 20 | | | | | 1909 | " | Lines West | | |
| 35.5 | | | | 24 | | | | | 1910 | " | " " | | |
| 35.6 | 7x8x8½ | Sawed | | 65,725 | N. Y. & Penn. | 21" | | | 1902 | P.S.&N. | New York | 42% Curve 58% Tang. | 1.3 |
| 35.7 | 7x8x8½ | | Seasoned | 20,219 | " | 21" | | | 1902 | " | " " | 50% Curve 50% Tang. | 1.5 |
| 35.8 | 7x7x8½ | Hewed | " | 137,000 | | 18 to Rl. | | | 1904-06 | Wash. Term.C. | Washington, D.C. | | |
| 35.9 | 6x8x8 | Sawed Hewed | " | 546 | | | | | 1909 | I.C. | Kankakee, Ill. | | |
| 35.10 | 6x8x8 | Sawed Hewed | " | 274 | | | | | 1910 | " | Bloomington, Ill. | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | OAK—(White ). | | | | | | | | | | |
| | | | | | | | 'CR | EOS | OTE. | | | | | | |
| 31.1 | Yes | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 31.2 | " | | " | 90 | " | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 31.3 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 32.1 | Rolled St. | 7x8½x½ | | 85 | Slag | | 1915 | 5.0 | 0 | | | Sound | | | 47.00 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 33.1 | Economy | | Cut | 90 | Gravel | 5,397,567 | 1916 | 2.0 | 0 | | | Excellent | | | 51.00 |
| | | | | | CR | EOSOTE | —( | NO | STEA | M). | | | | | |
| 34.1 | | | | | | | 1916 | 6.0 | 3.0 | | 3.0 | Good | | 6% are checked, split or rail-cut. | 35.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 35.1 | | | | | | | 1916 | 4.0 | 0 | | | | | | |
| 35.2 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 12.5 | | | | | 20% Ave. sapwood. | 8.10 |
| 35.3 | Yes | | " | 90 | Gravel | | 1916 | 6.0 | 20.0 | | | | | | 5.20 |
| 35.4 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 10.0 | | | | | | 5.20 |
| 35.5 | " | | " | 85-90 | Stone, Bt. Clay | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 35.6 | Wal-haupter | ⅛x6x8½ | " | 85 | Slag | 4,000,000 | 1916 | 14.0 | 70.0 | 70.0 | | Good | | Renewals began 1911. Includes Yellow Pine. | 1.761 |
| 35.7 | " | ⅛x6x8½ | " | 85 | Gr. and Slag | 4,000,000 | 1916 | 14.0 | 60.0 | 60.0 | | Fairly Good | | Includes Yellow Pine. | 1.761 |
| 35.8 | P. R. R. Flat bot. | 7x10¾ | " | 85 | Stone Cin. | 1,460,000 | 1916 | 10-12 | 96.3 | | | | | Traffic is estimated. | 4.11 |
| 35.9 | Economy | 6x8 | " | 90 | Stone | | 1916 | 7.0 | 50.7 | 20.3 | | | | 50% tie-plated 30.4% removed acct. derailment. | 12.11 |
| 35.10 | Sellers | 6x8 | " | 75 | Gravel | | 1916 | 6.0 | 0 | | | | | 50% tie-plated. | 12.11 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | OAK—(White)—(*Continued*). | | | | | | |
| 35.11 | 6x8x8 | Sawed Hewed | Seasoned | 274 | | | | | 1910 | I.C. | Bloomington, Ill. | | |
| 35.12 | 6x8x8 | Sawed Hewed | " | 274 | | | | | 1909 | " | Fulton, Ky. | | |
| 35.13 | 6x8x8 | Sawed Hewed | " | 274 | | | | | 1909 | " | " " | | |
| 35.14 | 6x8x8 | | | 50 | | 19 to 33" | | | 1907 | C.&N.W. | Janesville, Wis. | | |
| 35.15 | 7x9x8½ | | " | 760 | | | | | 1911 | B.&O. | Windsor, O. | | |
| 35.16 | 7x9x8 | Hewed | | 75 | South-West | 17 to Rl. | | | 1911 | C.M.& St.P. | Cowgill, Mo. | 2° Curve | |
| 35.17 | 6x8x8 | " | | 280 | Ark. | 18 to Rl. | | | 1911 | C.M.& St.P. | Braymer, Mo. | Tang. | 0 |
| 35.18 | 6x8x8 | | | 500 | Kan. | 18 to Rl. | | | 1903 | " | Washington, Ia. | " | 0 |
| 35.19 | 8x7x9 | Sawed | " | 34 | Ala. | | | | 1910 | T.C.I.&R. | Ensley, Ala. | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 36.1 | | | | 15 | | | | 0.50 | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 36.2 | | | | 10 | | | | 0.50 | 1910 | " | Blanding, Ill. | | |
| 36.3 | | | | 15 | | | | 0.50 | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC-CREOSOTE | | —(CARD). | | | | | |
| 37.1 | | | | 162 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 37.2 | | | | 351 | | | | Zn. 0.50 Cre. 3.00 | 1908 | " | Chicago, Div. | | |
| 37.3 | | | | 75 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | Lines East | | |
| 37.4 | | | | 92 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 37.5 | | | | 60 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | OAK–(White )—(*Continued*). | | | | | | | | | | |
| 35.11 | Sellers | 6x8 | Cut | 75 | Gravel | | 1916 | 6.0 | 10.9 | 10.9 | | | | 50% tie-plated. | 12.11 |
| 35.12 | " | 6x8 | " | 90 | " | | 1916 | 7.0 | 65.0 | 65.0 | | | | Ties worn out and split acct. badly creeping track. | 12.11 |
| 35.13 | " | 6x8 | " | 90 | " | | 1916 | 7.0 | 38.0 | 38.0 | | | | Ties worn out and split acct. badly creeping track. | 12.11 |
| 35.14 | None | | " | 90 | " | | 1916 | 8.5 | 38.0 | | | 62% Partly decayed | | | 26.00 |
| 35.15 | Shoulder Flange | | " | 90 | " | 10.586,000 | 1916 | 5.0 | 0 | | | 95.2% Good | | 4.8% are decayed. | 4.11 |
| 35.16 | None | | " | 85 | Burnt Clay | Heavy | 1916 | 5.0 | 2.7 | | | 77.3% Good | | | 6.11 |
| 35.17 | " | | " | 85 | " | " | 1916 | 5.0 | 0 | | | 76.4% Good | | | 6.11 |
| 35.18 | " | | " | 85 | Gravel | " | 1916 | 13.0 | 67.0 | | | 24.6% Fair | | Ties removed mostly acct. decay. | 6.11 |
| 35.19 | Goldie | | " | | Sand & Dirt | | 1915 | 5.5 | 20.6 | 20.6 | | | | Tie-plates on curves only. 64.7% decayed or partly decayed. | 21.00 |
| | | | | | ZINC CHLORIDE—(BURNETT). | | | | | | | | | | |
| 36.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 36.2 | " | | " | 90 | " | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 36.3 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | ZINC-CREOSOTE—(CAR D). | | | | | | | | | | |
| 37.1 | Partly | | Cut | 75-85-90 | | | 1916 | 7.0 | 4.3 | | | | | | 5.20 |
| 37.2 | All | | " | 90 | Gravel | | 1916 | 8.0 | 6.6 | | | | | | 5.20 |
| 37.3 | " | | " | 90 | | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 37.4 | " | | " | 85-90 | | | 1916 | 7.0 | 2.2 | | | | | | 5.20 |
| 37.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | OHIA. | | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 1.1 | | Sawed | Seasoned | 108 | | | | | 1910 | A.T.& S.F. | Hutchinson Cut-off | | |
| 1.2 | | Hewed | " | 132 | | | | | 1910 | " | H. Cut-Off | | |
| | | | | | | | PINE—(L | oblolly). | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 7x9x8 | Hewed | Seasoned | 45 | Minn. | 19 to Rl. | 22.8 | 6.5 | 1908 | N.P. | Sumner, Wash. | Tang. | 0 |
| | | | | | | | PINE—(Ja | ck). | | | | | |
| | | | | | | | CREO | SOTE. | | | | | |
| | | | | | | (See | Pine, Index | No. 25.1). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 2.1 | 7x9x8½ | " | Seasoned 6 mos. | 1,000 | | | 35.0 | 10.0 | 1907 | Ga.R.R. | Union Point, Ga. | Tang. | |
| 2.2 | 7x9x8½ | " | Seasoned 10 mos. | 1,000 | | | 35.0 | 10.0 | 1907 | " | Barnett, Ga. | " | |
| 2.3 | 8x9x8½ | " | | 50 | | 20" | | 17.4 | 1910 | Q.&C. | Birmingham, Ala. | | |
| 2.4 | | | | 88 | | | | 22.19 | 1909 | C.B.&Q. | Lines East | | |
| 2.5 | | | | 50 | | | | 22.19 | 1910 | " | " " | | |
| 2.6 | | | | 40 | | | | 22.19 | 1909 | " | Lines West | | |
| 2.7 | | | | 31 | | | | 22.19 | 1910 | " | " " | | |
| 2.8 | 7x8x8½ | Sawed Hewed | Seasoned | 2,743 | | 18 to 33' | 30-40 | 8-10 | 1910 | Penn. | Wooster, O. | Tang. & 3°-5°Cv. | 0.8 down |
| | | | | | | CREOS | OTE—(NO | STEAM). | | | | | |
| 3.1 | | | Seasoned 3 mos. | 292 | Ark. | | | 12.0 | 1910 | St.L.& S.W. | Texarkana, Tex. | | |

| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | OHIA. | | | | | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 1.1 | | 7½x9 | Screw | 90 | Rock | | 1916 | 6.0 | 0 | | | | | | 45.10 |
| 1.2 | | 7½x9 | " | 90 | " | | 1916 | 6.0 | 0 | | | | | | 45.10 |
| | | | | | PINE—(Jack | ). | | | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Flat 4 ridges | 6x8¼x 9/16 | Cut | 85 | Gravel | Heavy | 1915 | 7.0 | 0 | | | O. K. | | | 19.00 |
| | | | | | PINE—(Lobl | olly). | | | | | | | | | |
| | | | | | | | CR | EOS | OTE. | | | | | | |
| | | | | | | (See P | ine, | Inde | x No. | 25.1). | | | | | |
| | | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | |
| 2.1 | None | | Cut | 65 | Cinders | 900,000 | 1916 | 9.0 | 3.3 | | | | | In passing siding. | 34.00 |
| 2.2 | " | | " | 65 | " | 300,000 | 1916 | 9.0 | 2.3 | | | | | Sap Pine. In passing siding. | 34.00 |
| 2.3 | Rolled St. | 7x8¼x½ | " | 85 | Slag | | 1915 | 5.0 | 0 | | | Sound | | | 47.00 |
| 2.4 | Partly | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 2.5 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 2.6 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 2.7 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 2.8 | " | 7x9 to 7x13½ | C. & S. | 100 | Stone | 14,000,000 | 1916 | 6.0 | 62.0 | | 62.0 | Good | | | 20.11 |
| | | | | | | CR | EOSOTE | —( | NO | STEA | M). | | | | |
| 3.1 | | | | | | | 1916 | 6.0 | 0.7 | | 0.7 | Good | | 4.5% are rail-cut, checked and split. | 35.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | PINE—(L | oblolly)— | (*Con* | *tinued*). | | | |
| | | | | | | CRE | OSOTE—(S | TEAMED). | | | | | |
| 4.1 | | | Unseasoned | 299 | Texas | | | 12.0 | 1910 | St.L.& S.W. | Texarkana, Tex. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| | | | | | | See | Pine Index | Nos. 36.1- | 36.12). | | | | |
| 5.1 | 6x8x8 | Hewed Sawed | Seasoned | 274 | | | | 5.00 | 1909 | I.C. | Fulton, Ky. | | |
| 5.2 | 6x8x8 | Hewed Sawed | " | 274 | | | | 5.00 | 1910 | " | Greenville, Miss. | | |
| 5.3 | 6x8x8 | Hewed Sawed | " | 273 | | | | 5.00 | 1909 | " | Kankakee, Ill. | | |
| 5.4 | 6x8x8 | Hewed Sawed | " | 274 | | | | 5.00 | 1910 | " | Bloomington, Ill. | | |
| 5.5 | 6x8x8 | | | 3,200 | | | | 5.00 | 1907 | " | Corinth, Miss. | | |
| 5.6 | 6x8x8 | Hewed Sawed | | 2,880 | | | | 6.00 | 1907 | " | " " | | |
| | | | | | | | CRESOL-CA | LCIUM. | | | | | |
| | | | | | | (See Pi | ne Index No | s. 29.1-29.4 | ). | | | | |
| | | | | | | | J. M. LONG'S | LIQUID. | | | | | |
| 6.1 | | | " | 174 | | | | 0.826 | 1910 | I.C. | Greenville, Miss. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 7.1 | | | | 110 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 7.2 | | | | 24 | | | | | 1908 | " | " " | | |
| 7.3 | | | | 48 | | | | | 1910 | " | " " | | |
| 7.4 | | | | 60 | | | | | 1909 | " | Lines West | | |
| 7.5 | | | | 29 | | | | | 1910 | " | " " | | |

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| Index No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PINE—(Lobl | olly)— | (C | onti | nued | ). | | | | | |
| | | | | | | CREOSO | TE | —( | STEA | MED | ). | | | | |
| 4.1 | | | | | | | 1916 | 6.0 | 0 | | | Good | | 6.4% are rail-cut checked and split. | 35.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| | | | | | (See | Pine Ind | ex | Nos. | 36.1- | 36.12 | ). | | | | |
| 5.1 | Sellers | 6x8 | Cut | 90 | Gravel | | 1916 | 7.0 | 21.2 | | 21.2 | | | Worn out and split, acct. badly creeping track. | 12.11 |
| 5.2 | " | 6x8 | " | 75 | " | | 1916 | 6.0 | 8.0 | | 8.0 | | | Gravel ballast since 1912, 50% tie plated. Removed acct. wind-shakes, made worse by crushing. | 12.11 |
| 5.3 | " | 6x8 | " | 90 | Stone | | 1916 | 7.0 | 9.9 | | | | | 50% tie-plated. Removed acct. derailment. | 12.11 |
| 5.4 | " | 6x8 | " | 75 | Gravel | | 1916 | 6.0 | 0 | | | | | 50% tie-plated. | 12.11 |
| 5.5 | None | | | 85 | " | Not Heavy | 1916 | 9.0 | 0.03 | | | Good | | Slightly rail-cut. | 12.11 |
| 5.6 | " | | | 85 | " | " | 1916 | 9.0 | 0.03 | | | " | | Slightly rail-cut. | 12.11 |
| | | | | | | CRESOL | —C | AL | CIU | M. | | | | | |
| | | | | | (See | Pine Ind | ex | Nos. | 29.1- | 29.4 | ). | | | | |
| | | | | | | J. M. | LO | NG' | S LIQ | UID. | | | | | |
| 6.1 | ½ with Economy | | Cut | 75 | Dirt | | 1916 | 6.0 | 100.0 | 100.0 | | | 5.5 | | 12.11 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 7.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 89.1 | | | | | | 5.20 |
| 7.2 | " | | " | 90 | Gravel | | 1916 | 8.0 | 95.8 | | | | | Tie-plates on curves. | 5.20 |
| 7.3 | All | | " | 90 | " | | 1916 | 6.0 | 54.2 | | | | | | 5.20 |
| 7.4 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 98.4 | | | | | | 5.20 |
| 7.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 78.1 | | | | | | 5.20 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | PINE—(L | oblolly)— | (*Con | *tinued*). | | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | | | (See | Pine Index N | os. 37.1-37.4 | ). | | | | |
| 8.1 | 6x8x8 | Hewed | Seasoned | 274 | | | | 0.50 | 1909 | I.C. | Fulton, Ky. | | |
| 8.2 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1910 | " | Greenville, Miss. | | |
| 8.3 | 6x8x8 | Sawed Hewed | " | 273 | | | | 0.50 | 1909 | " | Kankakee, Ill. | | |
| 8.4 | 6x8x8 | Sawed Hewed | " | 274 | | | | 0.50 | 1910 | " | Bloomington, Ill. | | |
| 8.5 | | Sawed | | 70 | | | | 0.50 | 1909 | C.B.&Q. | Lines East | | |
| 8.6 | | | | 50 | | | | 0.50 | 1910 | " | " " | | |
| 8.7 | | | | 43 | | | | 0.50 | 1909 | " | Lines West | | |
| 8.8 | | | | 30 | | | | 0.50 | 1910 | " | " " | | |
| | | | | Z | INC- | CREOS | OTE—(ALL | ARDYCE) | NO S | TEAM. | | | |
| 9.1 | | | Seasoned | 100 | | | | | 1911 | St.L.& S.W. | Texarkana, Tex. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 10.1 | | | | 160 | | | | Zn. 0.50 Cre. 3.00 | 1908 | C.B.&Q. | Lines East | | |
| 10.2 | | | | 426 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | " " | | |
| 10.3 | | | | 472 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 10.4 | | | | 50 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | " " | | |
| 10.5 | | | | 267 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 10.6 | | | | 121 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | PINE—(Lobl | olly)— | (*C* | *onti* | *nued* | ). | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 8.1 | Sellers | 6x8 | Cut | 90 | Gravel | | 1916 | 7.0 | 36.9 | | 36.9 | | | Worn-out and split acct. badly creeping track. | 12.11 |
| 8.2 | " | 6x8 | " | 75 | " | | 1916 | 6.0 | 40.1 | 18.2 | 21.9 | | | Gravel ballast since 1912 50% tie-plated. | 12.11 |
| 8.3 | " | 6x8 | " | 90 | Stone | | 1916 | 7.0 | 19.0 | | | | | 50% tie-plated. Removed acct. derailment. | 12.11 |
| 8.4 | " | 6x8 | " | 75 | Gravel | | 1916 | 6.0 | 0 | | | | | 50% tie-plated. | 12.11 |
| 8.5 | Partly | | " | 75-85-90 | Cin., Gr. Bt. Cl. | | 1916 | 7.0 | 2.9 | | | | | | 5.20 |
| 8.6 | All | | " | 90 | Gravel | | 1916 | 6.0 | 16.0 | | | | | | 5.20 |
| 8.7 | Yes | | " | 85-90 | Cin., Gravel | | 1916 | 7.0 | 4.6 | | | | | | 5.20 |
| 8.8 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 16.7 | | | | | | 5.20 |
| | | | | | ZINC-CR | EOSOTE | —( | ALL | ARDY | CE) | —No | Steam. | | | |
| 9.1 | | | | | | | 1916 | 5.0 | 0 | | | Good | | 8% rail-cut and checked | 35.00 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 10.1 | Partly | | Cut | 90 | Gravel | | 1916 | 8.0 | 78.1 | | | | | Tie-plates on curves. | 5.20 |
| 10.2 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0.9 | | | | | | 5.20 |
| 10.3 | All | | " | 90 | Gravel | | 1916 | 6.0 | 3.2 | | | | | | 5.20 |
| 10.4 | Yes | | " | 75 | " | | 1916 | 5.0 | 18.0 | | 18.0 | | | 85 lb. rail since 1913. No tie-plates under joints. | 5.20 |
| 10.5 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 10.6 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 45.5 | | | | | | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | PINE—(Lodgepole). | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 11.1 | | Hewed Sawed | Seasoned | 39 | | | | 8.841 | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | C | REOS | OTE— | (FULL-CEL | L—LOWR | Y—RU | EPING). | | | |
| 12.1 | | | | 58 | | | | | 1907 | C.B.&Q. | Sheridan, Wyo. | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 13.1 | 7x8x8 | Hewed | Seasoned 6-9 mos | 50 | Mont. & Ida. | 19 to Rl. | 26.9 | 8.62 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.30 |
| 13.2 | 7x8x8 | " | " | 50 | " | 19 to Rl. | 26.9 | 8.62 | 1915 | " | " " | 2° Curve | 0.30 |
| 13.3 | 7x8x8 | " | " | 50 | " | 19 to Rl. | 26.9 | 8.62 | 1915 | " | " " | Tang. | 0.40 |
| 13.4 | 7x8x8 | " | " | 49 | " | 19 to Rl. | 26.9 | 8.62 | 1915 | " | " " | " | 0.40 |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 14.1 | | Hewed Sawed | Seasoned | 25 | | | | 4.92 | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 15.1 | | Hewed Sawed | Seasoned | 10 | | | | | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 16.1 | | | | 1,996 | | | | | 1906 | C.B.&Q. | Sheridan, Wyo. | | |
| 16.2 | | Hewed Sawed | Seasoned | 63 | | | | 0.309 | 1905 | " | Ellsberry, Mo. | Tang. | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | PINE—(Lod | gepole). | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 11.1 | Sellers | | Cut | | | | 1916 | 11.2 | 7.8 | | | 82% O. K. 7.8% rail cut | | 2.4% doty. | 5.20 |
| | | | | | CREOSOTE | —(FULL | -CE | LL | —LO | WRY | —RU | EPING). | | | |
| 12.1 | Sellers | | Cut | 85 | Ballentine Gr. | | 1916 | 9.5 | 1.8 | | 1.8 | | | Removed acct. rail-cut. | 5.20 |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 13.1 | N.P.Std. | 7x9 | Cut | 90 | Gravel & Sand | 8.270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 13.2 | Vignoles bolted to | Rail Ch ties | airs | 90 | " | 8.270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 13.3 | Vignoles bolted to | Rail Ch ties | airs | 90 | " | 8.270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 13.4 | N.P.Std. | 7x9 | " | 90 | " | 8.270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 14.1 | Sellers | | Cut | | | | 1916 | 11.2 | 8.0 | | | 72% O. K. 20% rail worn | | | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 15.1 | Sellers | | Cut | | | | 1916 | 11.2 | 60.0 | | | 20% O. K. 20% rail worn | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 16.1 | | | Cut | | | | 1916 | 10.0 | 2.9 | | | Very Good | | | 5.20 |
| 16.2 | Sellers | | Cut | | | | 1916 | 11.2 | 47.6 | | | 28.6%O.K. 17.4% rail worn | | 6.4% doty. | 5.20 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | PINE | —(Lodgepo | le)—(*Co* | *ntinu* | *ed*). | | | |
| | | | | | | ZINC- | CREOSOTE | —(ALLAR | DYCE | ). | | | |
| 17.1 | | Hewed Sawed | Seasoned | 77 | | | | Zn. 0.384 Cre. 1.652 | 1905 | C.B.&Q. | Elsberry, Mo. | Tang. | |
| | | | | | | CREO | SOTE—(BE | THELL). | | | | | |
| | | | | | | (See | Pine, Index | No. 34.1). | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 18.1 | 7x9x8½ | Hewed | | 50 | | 20" | | 17.4 | 1910 | Q.&C. | Birmingham, Ala. | | |
| 18.2 | 7x9x8½ | | | 252 | N.Car. | | | | 1887 | A.C.L. | Halifax, N. C. | | |
| | | | | | | CREOS | OTE—(NO | STEAM). | | | | | |
| 19.1 | | | Seasoned | 300 | La. | | | 8.0 | 1910 | St.L.& S.W. | Texarkana, Tex. | | |
| | | | | | | CRE | OSOTE—(S | TEAMED). | | | | | |
| 20.1 | | | Unseasoned | 300 | La. | | | 12.0 | 1910 | St.L.& S.W. | Texarkana, Tex. | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| 22.1 | 6x8x8 | Sawed | | 2,100 | | 19 to Rl. | | | 1899 | C.M.& St.P. | Rio, Wis. | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | PINE—(Lod | gepole) | —( | *Co* | *ntinu* | *ed*). | | | | | |
| | | | | | ZINC | CREOSO | TE | —A | LI.A | RDY | CE). | | | | |
| 17.1 | Sellers | | Cut | | | | 1916 | 11.2 | 7.8 | | | 57.1% Good 33.8% rail worn | | 1.3% doty. | 5.20 |
| | | | | | PINE—(Lon | gleaf). | | | | | | | | | |
| | | | | | CREOSOTE— | STEAMI | NG | —(B | ETH | ELL | ). | | | | |
| | | | | | | (See Pin | e In | dex | No. 3 | 4.1). | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 18.1 | Rolled St. | 7x8¼x½ | Cut | 85 | Slag | | 1915 | 5.0 | 0 | | | Sound | | | 47.00 |
| 18.2 | None | | | | Sound | Light | 1916 | 28.0 | 75.0 | | | Good | | Supposedly grown in N. Carolina. Removed acct. rail-cut and decay. | 49.00 |
| | | | | | CR | EOSOTE | —( | NO | STEA | M). | | | | | |
| 19.1 | | | | | | | 1916 | 6.0 | 0.3 | | 0.3 | Good | | Seasoned 3 mos. before and 3 mos. after treatment. 3% rail-cut, split checked. | 35.00 |
| | | | | | | CREOSO | TE | —( | STEA | MED | ). | | | | |
| 20.1 | | | | | | | 1916 | 6.0 | 0.3 | | 0.3 | Good | | Seasoned 4 mos. after treatment, 4.3% rail-cut, split and checked. | 35.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 22.1 | None | | Cut | 90 | Gravel | Heavy | 1916 | 17.0 | 89.0 | | | Rail-cut ½-¾" | | 4% more to be removed in 1916. Removed acct decay, split and wear. | 6.11 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | PINE—(Longleaf)— | | (*Continued*). | | | | |
| 22.2 | 8x7x9 | " | Seasoned | 96 | Ala. | | | | 1910 | T.C.I.&R. | Ensley, Ala. | | |
| 22.3 | 7x9x8 | " | | 184 | | | | | 1905 | G.H.& S.A. | Bay View | | |
| 22.4 | 7x9x8 | " | | 434 | | | | | 1905 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| | | | | | | (See | Pine Index | Nos. 37.1-37.4). | | | | | |
| 23.1 | 8x10x8½ | " | | 68 | | | | | 1901 | N.Y.N. H.&H. | Rowayton, Conn. | | |
| 23.2 | 8x10x8½ | " | | 67 | | | | | 1901 | " | " " | | |
| | | | | | | | PINE—(Scrub). | | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 24.1 | 6x8x8 | Hewed | Seasoned | 196 | So. Ind. | 20" | 24.5 | 9.20 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| | | | | | | | PINE—(Shortleaf). | | | | | | |
| | | | | | | | CREO | SOTE. | | | | | |
| 25.1 | 8x7x9 | Sawed | Seasoned | 113 | Ala. | | | 7.00 | 1910 | T.C.I.&R. | Ensley, Ala. | | |
| | | | | | | CREO | SOTE—(BETHELL). | | | | | | |
| | | | | | | (See | Pine, Index | No. 34.1). | | | | | |

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| Index No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SERVICE CONDITIONS—*(Continued)*. | | | | | | RESULTS. | | | | | | | | |
| | | | | | PINE—(Lon | gleaf)— | (C | ont | inued | ). | | | | | |
| 22.2 | Goldie | | " | | Sand & Dirt | | 1915 | 5.5 | 18.8 | 18.8 | | | | Tie-plates on curves only. 75% decayed or partly decayed. | 21.00 |
| 22.3 | | | Screw | | | | 1916 | 11.0 | 100.0 | | | | 4.0 | | 7.10 |
| 22.4 | None | | | | | | 1916 | 11.0 | 99.6 | | | | | | 7.10 |
| | | | | | ZINC | CHLORI | DE | —( | BUR | NET | TE). | | | | |
| | | | | | (See Pine Index | Nos. 37.1- | 37.4 | ). | | | | | | | |
| 23.1 | | 5x8 | Cut | 100 | Stone | | 1916 | 15.0 | 100.0 | | | | 14.4 | | 38.10 |
| 23.2 | | 5x8 | " | 100 | " | | 1916 | 15.0 | 100.0 | | | | 14.8 | | 38.10 |
| | | | | | PINE—(Scru | b). | | | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 24.1 | Economy | 5x8 | Cut | 90 | Gravel | 5,297.567 | 1916 | 2.0 | 0 | | | Excellent | | | 51.00 |
| | | | | | PINE—(Sho | rtleaf). | | | | | | | | | |
| | | | | | | | CR | EOS | OTE. | | | | | | |
| 25.1 | Goldie | | Cut | | Sand & Dirt | | 1915 | 5.5 | 6.2 | 6.2 | | 77% Good | | Includes loblolly Pine Tie-plates on curves only. 16.8% decayed or partly decayed. | 21.00 |
| | | | | | | CREOSO | TE | —(B | ETHE | LL). | | | | | |
| | | | | | | (See Pin | e In | dex | No. 3 | 4.1). | | | | | |



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## Cross-Tie Records—Service Tests—(*Continued*).

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | PINE | —(Shortlea | f)—(*Cont* | *inued* | ). | | | |
| | | | | | | CREOS | OTE—(NO | STEAM). | | | | | |
| 26.1 | | | Seasoned 4 mos. | 263 | Ark. | | | 12.00 | 1910 | St.L.& S.W. | Dodridge, Ark. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 27.1 | 7x8x8½ | Hewed Sawed | Seasoned | 2,494 | | 18 to 33' | 22.5 | 6.80 | 1907 | Penn. | Scio, O. | Tang. | 0.1 up |
| | | | | | | CRE | OSOTE—(S | TEAMED). | | | | | |
| 28.1 | | | | 300 | Ark. | | | 12.00 | 1910 | St.L.& S.W. | Dodridge, Ark. | | |
| | | | | | | | CRESOL-CA | LCIUM. | | | | | |
| 29.1 | 8x7x9 | Sawed | Seasoned | 104 | Ala. | | | 1.15 | 1910 | T.C.I.&R. | Ensley, Ala. | | |
| 29.2 | 8x7x9 | " | " | 103 | " | | | 0.85 | 1910 | " | " " | | |
| 29.3 | 8x7x9 | " | " | 98 | " | | | 0.51 | 1910 | " | " " | | |
| 29.4 | 8x7x9 | " | " | 93 | | | | 0.27 | 1910 | " | " " | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates Kind | Tie Plates Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Re-moved % | Cause R'm'v'l Decay % | Cause R'm'v'l Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-erence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PINE—(Sho | rtleaf) | —( | *Con* | *tinue* | *d*). | | | | | |
| | | | | | CR | EOSOTE | —( | NO | STEA | M). | | | | | |
| 26.1 | | | | | | | 1916 | 6.0 | 1.5 | | | Good | | Removed acct. crushed. 5.3% rail-cut, split and checked. | 35.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 27.1 | Flat | 6x9 | C. & S. | 100 | Stone | | 1916 | 9.0 | 64.0 | | 64.0 | Good | | | 20.11 |
| | | | | | | CREOSO | TE | —( | STEA | MED | ). | | | | |
| 28.1 | | | | | | | 1916 | 6.0 | 0 | | | Good | | Seasoned 3 mos. after treatment. 16.7% rail-cut, split and checked. | 35.00 |
| | | | | | | CRESOL | —C | AL | CIU | M. | | | | | |
| 29.1 | Goldie | | Cut | | Sand & Dirt | | 1915 | 5.5 | 1.0 | 1.0 | | | | Includes loblolly pine. Tie-plates on curves only. 88.4% decayed and partly decayed. | 21.00 |
| 29.2 | " | | " | | " | | 1915 | 5.5 | 16.5 | 16.5 | | | | Includes loblolly pine. Tie-plates on curves only. 83.5% decayed and partly decayed. | 21.00 |
| 29.3 | " | | " | | " | | 1915 | 5.5 | 24.5 | 24.5 | | | | Includes loblolly pine. Tie-plates on curves only. 74.5% decayed and partly decayed. | 21.00 |
| 29.4 | " | | " | | " | | 1915 | 5.5 | 32.2 | 32.2 | | | | Includes loblolly pine. Tie-plates on curves only. 67.8% decayed and partly decayed. | 21.00 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | PINE ZINC | —(Shortlea CHLORIDE | f)—(*Cont* —(BURNE | *inued* TT). | ). | | | |
| | | | | | | (See | Pine Index | Nos. 37.1- | 37.4). | | | | |
| 30.1 | 6x8x8 | | Seasoned | 500 | | 22" | 1.3 | 0.50 | 1907 | C.M.& St.P. | Morristown, S.D. | Tang. | 0.6 |
| 30.2 | 6x8x8 | Sawed | " | 500 | Texas. | 18 to Rl. | 1.3 | 0.50 | 1903 | " | Washington, Ia. | " | 0 |
| | | | | Z | INC- | CREOS | OTE—(ALL | ARDYCE) | NO S | TEAM. | | | |
| 31.1 | | | Seasoned | 100 | Texas. | | | | 1911 | St.L.& S.W. | Texarkana, Tex. | | |
| | | | | | | DIAM | PINE— OND WOOD | (Sap). PRESERV | ER. | | | | |
| 32.1 | 7x9x8 | Hewed | | 500 | | | Gal. 0.4 | Gal. 0.11 | 1907 | G.H.& S.A. | Ft. Hancock | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 32.2 | 7x9x8 | " | | 334 | | | 1.443 | 0.4122 | 1905 | G.H.& S.A. | Bay View. | | |
| 32.3 | 7x9x8 | " | | 333 | | | 1.443 | 0.4122 | 1905 | " | " " | | |
| 32.4 | 7x9x8 | " | | 334 | | | 1.443 | 0.4122 | 1905 | " | " " | | |
| | | | | | | | ZINC-CREO | SOTE. | | | | | |
| 32.5 | 7x8x8 | " | | 127 | | | Zn. 1.01 C. 17.7 | Zn. 0.27 Cre. 4.49 | 1905 | " | Galveston | | |
| 32.6 | 7x8x8 | " | | 750 | | | Zn. 1.01 C. 17.7 | Zn. 0.27 Cre. 4.49 | 1905 | " | " | | |
| 32.7 | 7x8x8 | " | | 126 | | | Zn. 1.01 C. 17.7 | Zn. 0.27 Cre. 4.49 | 1905 | " | " | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
| | | | | | PINE—(Shor ZINC | tleaf)—CHLORI | (C DE | onti —( | nued BURN | ). ETT | ). | | | | |
| | | | | | (See | Pine In | dex | No | s. 37 | .1-37 | .4). | | | | |
| 30.1 | Malleable | 6x8 | Cut | 85 | Sand to 60% Burnt Clay Gravel | 5,562,600 | 1916 | 9.0 | 10.0 | | | Good | | Removed acct. decay and split. | 6.11 |
| 30.2 | Mal. Iron | 5x7½ | " | 85 | | Heavy | 1916 | 13.0 | 20.0 | | 20.0 | 70% Slightly rail-cut | | Tie-plates since 1911. 10% badly rail-cut. 5% decayed. | 6.11 |
| | | | | | ZINC-CR | EOSOTE | —( | ALL | ARDY | CE) | —No | Steam. | | | |
| 31.1 | | | | | | | 1916 | 5.0 | 1.0 | | | Good | | Removed acct. split. 8% split, checked, rail-cut. | 35.00 |
| | | | | | PINE—(Sap). | | | | | | | | | | |
| 32.1 | Glendon | | Cut | | Slag | | 1916 | 9.5 | 38.6 | | | | | Decaying fast. | 7.10 |
| | | | | | ZINC CHLORI | DE—(B | UR | NE | TT). | | | | | | |
| 32.2 | | | Screw | | | | 1914 | 9.0 | 100 | | | | 5.4 | Seasoned 3 mos. after treatment. | 7.10 |
| 32.3 | Glendon | | | | | | 1916 | 11.0 | 99.3 | | | | | Seasoned 3 mos. after treatment. | 7.10 |
| 32.4 | None | | | | | | 1916 | 11.0 | 100.0 | | | | 5.7 | Seasoned 3 mos. after treatment. | 7.10 |
| | | | | | | ZINC- | CRE | OS | OTE. | | | | | | |
| 32.5 | None | | | | | | 1916 | 11.0 | 51.2 | | | | | | 7.10 |
| 32.6 | | | Screw | | | | 1916 | 11.0 | 43.9 | | | | | Creosote 8 mos. after Zinc. | 7.10 |
| 32.7 | Glendon | | " | | | | 1916 | 11.0 | 6.3 | | | | | Creosote 8 mos. after Zinc. | 7.10 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | | |
| | | | | | | PINE | -(Southern | Yellow). | | | | | | |
| | | | | | | | CREO | SOTE. | | | | | | |
| 22.2 | 8x7x9 | Sawed | | 6,000 | | | | 10.00 | 1894 | N.Y.N H.&H. | Fanhaven Tunnel | | | |
| 33.2 | 7x9x8 | " | | 500 | | | | | 1906 | " | " | " | | |
| 33.3 | 7x9x8 | " | | 200 | | | | | 1907 | " | " | " | | |
| | | | | | | CREO | SOTE—(BE | THELL). | | | | | | |
| 34.1 | 7x9x8½ | " | Green | 1,274 | Miss. | 22" | 44.6 | 12.0 | 1907 | L.&N. | Miss. | | 30' Curve | 0.44 |
| 34.2 | 6x10x8 | | | 868 | | | Gal. 4.42 | Gal. 1.326 | 1909 | G.H.& S.A. | Bay View | | | |
| 34.3 | 7x9x9 | " | | 285 | | | | 12.00 | 1906 | " | Lafayette | | | |
| 34.4 | | | | 205 | | | | | 1906 | " | Salix | | | |
| 34.5 | 6x10x8 | | | 1,963 | | 18 to 33' | | 1.30 | 1911 | " | Olivier | | | |
| 34.6 | 6x10x8 | | | 849 | | 16 to 33' | | 1.30 | 1911 | " | " | | | |
| 34.7 | 6x10x8 | | | 295 | | 14 to 30' | | 1.30 | 1911 | " | " | | | |
| 34.8 | 6x10x8 | | | 731 | | 16 to 33' | | 1.30 | 1911 | " | " | | | |
| 34.9 | 7x9x9 | " | | 205 | | | | | 1907 | " | Salix | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | | |
| 35.1 | | | Seasoned | 99 | | | Gal. 3.5 | | 1915 | D.&L.W. | Paterson, N. J. | | | |
| 35.2 | 7x9x8½ | | " | 37 | | | Gal. 3.5 | | 1915 | " | Dover, N. J. | | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | | |
| 36.1 | | " | Seasoned | 173 | | | | 4.56 | 1905 | A.T.& S.F. | Chillicothe, Ill. | | | |
| 36.2 | | " | " | 304 | | | | 4.56 | 1905 | " | Marcelline, Mo. | | | |
| 36.3 | | " | " | 44 | | | | 4.56 | 1905 | " | Sutton, Kan. | | | |
| 36.4 | | " | " | 190 | | | | 4.56 | 1904 | " | Ponca City, Okla. | | | |
| 36.5 | | Sawed | " | 275 | | | | 3.93 | 1904 | " | Bliss, Okla. | | | |
| 36.6 | | " | " | 366 | | | | 3.93 | 1904 | " | Perry, Okla. | | | |
| 36.7 | | Hewed | " | 27 | | | | 4.56 | 1904 | " | Perry, Okla. | | | |
| 36.8 | | Sawed | " | 384 | | | | 3.93 | 1905 | " | Garnet, Kan. | | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-erence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PINE—(Sout | hern Ye | llow | ). | | | | | | | |
| | | | | | | | CR | EOS | OTE. | | | | | | |
| 33.1 | None | | Cut | 100 | Stone | Heavy | 1916 | 22.0 | 99.6 | | | | | 24 ties still in track. | 38.10 |
| 33.2 | | | " | 100 | " | " | 1916 | 10.0 | 0 | | | | | | 38.10 |
| 33.3 | | | " | 100 | " | | 1916 | 9.0 | 0 | | | | | | 38.10 |
| | | | | | | CREOSO | TE | —(B | ETHE | LL). | | | | | |
| 34.1 | Goldie | 7x6 | Cut | 70 | Slag | | 1916 | 9.0 | 0.24 | 0.16 | 0.08 | Fair | | Includes shortleaf and long. Joint plate 8x6. | 18.00 |
| 34.2 | Clark | 8½x10 | Screw | 80 | Gravel | | 1916 | 6.8 | 0 | | | Good | | | 7.10 |
| 34.3 | I. & W. | | Cut | | Gravel | | 1916 | 10.0 | 34.3 | | | | | | 7.10 |
| 34.4 | | | | | | | 1916 | 10.0 | 4.8 | | | | | | 7.10 |
| 34.5 | Clark | | Screw | 90 | " | | 1916 | 5.0 | 0 | | | | | 9 ties slightly decayed. | 7.10 |
| 34.6 | " | 8½x10 | " | 90 | " | | 1916 | 5.0 | 0 | | | | | 7 ties slightly decayed. | 7.10 |
| 34.7 | " | 8½x10 | " | 90 | " | | 1916 | 5.0 | 0 | | | | | 4 ties slightly decayed. | 7.10 |
| 34.8 | " | 8½x10 | " | 90 | " | | 1916 | 5.0 | 0.55 | | | | | 2 ties slightly decayed. | 7.10 |
| 34.9 | Yes | | Cut | | " | | 1916 | 9.0 | 4.8 | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 35.1 | Hook Shoulder | | S. & B. | 101 | Stone | | 1916 | 1.0 | 0 | | | | | | 44.10 |
| 35.2 | " | | " | 101 | " | | 1916 | 1.0 | 0 | | | | | | 44.10 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 36.1 | Yes | 6x8 | Cut | 85 | Gravel | 10,000,000 | 1916 | 11.0 | 4.0 | | | | | Loblolly pine predominates | 45.10 |
| 36.2 | " | 6x8 | " | 85 | " | 10,000,000 | 1916 | 11.0 | 38.8 | 2.6 | 5.9 | | | Loblolly pine predominates 30.3% removed for switch, etc. | 45.10 |
| 36.3 | " | 6x8 | " | 85 | Slag | 6,500,000 | 1916 | 11.0 | 9.1 | | 9.1 | | | Loblolly pine predominates | 45.10 |
| 36.4 | " | 7½x9 | " | 85 | Rock | 2,500,000 | 1916 | 12.0 | 4.2 | | 4.2 | | | " " " | 45.10 |
| 36.5 | " | 7½x9 | " | 90 | " | 2,500,000 | 1916 | 12.0 | 4.0 | | 4.0 | | | " " " | 45.10 |
| 36.6 | " | 7½x9 | " | 90 | " | 2,500,000 | 1916 | 12.0 | 0 | | | | | " " " | 45.10 |
| 36.7 | " | 7½x9 | " | 90 | " | 2,500,000 | 1916 | 12.0 | 0 | | | | | " " " | 45.10 |
| 36.8 | " | 7½x9 | " | 90 | " | 4,800,000 | 1916 | 11.0 | 10.4 | 10.4 | | | | " " " | 45.10 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | PINE | -(Southern | Yellow) | —(*C* | *ontinued* | ). | | |
| 36.9 | | Sawed | Seasoned | 572 | | | | 3.93 | 1905 | A.T.& S.F. | Argonia, Kan. | | |
| 36.10 | | " | " | 54,621 | | | | 5.00 | 1910 | " | Hutch. Cut-Off | | |
| 36.11 | | | " | 9,436 | | | | 5.00 | 1910 | " | " " | | |
| 36.12 | 6x8x8 | Hewed | " | 24,238 | | | | less than 5.00 | 1906 | " | Ottowa Cut-Off | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 37.1 | | Hewed | Seasoned | 9,251 | | | | 0.58 | 1905 | A.T.& S.F. | Newton, Kan. | | |
| 37.2 | | " | " | 6,357 | | | | 0.58 | 1904 | " | " " " | | |
| 37.3 | | Sawed | " | 2,517 | | | | 0.52 | 1904 | " | " " | | |
| 37.4 | | " | " | 40 | | | | 0.52 | 1905 | " | " " | | |
| 37.5 | 6x8x8 | " | " | 496 | Texas | 19 to Rl. | 1.50 | 0.50 | 1906 | C.M.& St.P. | Okaton, S. D. | 53.8% Cv. | |
| | | | | | | | ZINC-CREO | SOTE. | | | | | |
| 37.6 | | | | 1,095 | | | | | 1895 | G.H.& S.A. | Watkins, C. O. | | |
| 37.7 | 7x9x9 | Hewed | | 433 | | | Zn. 1.01 C. 17.7 | | 1907 | " | Salix | | |
| 37.8 | 7x9x9 | " | | 476 | | | Zn. 1.01 C. 17.7 | | 1906 | " | Lafayette | | |
| | | | | | | ZINC- | TANNIN—( | WELLHO | USE). | | | | |
| 38.1 | | " | Seasoned | 25 | | | | | 1897 | N.S. | Norfolk Div. | 2° Curve | |
| 38.2 | | Sawed | " | 100 | | | | | 1897 | " | " " | Tang. | |
| 38.3 | | Hewed | " | 100 | | | | | 1897 | " | " " | " | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—*(Continued).* | | RESULTS. | | | | | | | | |
| | | | | | PINE—(Southern Yellow)—(*Continued*). | | | | | | | | | | |
| 36.9 | Yes | 7½x9 | Cut | 90 | Rock | 5,130,000 | 1916 | 11.0 | 11.2 | 0.7 | 10.5 | | | Loblolly pine predominates | 45.10 |
| 36.10 | " | 7½x9 | Screw | 90 | " | 4,900,000 | 1916 | 6.0 | 0.14 | | 0.01 | | | " " " 1.3% burned. | 45.10 |
| 36.11 | " | 7½x9 | " | 90 | " | 4,900,000 | 1916 | 6.0 | 0 | | | | | Loblolly pine predominates | 45.10 |
| 36.12 | " | 6x8 7½x9 | Cut | 85 | " | 14,327,700 | 1916 | 10.0 | 0.03 | | | | | " " " 90 lb. rail laid 1914 removed acct. burned. | 45.10 |
| | | | | | ZINC CHLORIDE—(BURNETT). | | | | | | | | | | |
| 37.1 | Yes | 7½x9 | Cut | 85 | Rock | 15,000,000 | 1916 | 11.0 | 39.1 | 32.6 | | | | 6⅓% removed for experimental purposes. Mostly loblolly pine. | 45.10 |
| 37.2 | " | 7½x9 | " | 85 | " | 15,000,000 | 1916 | 12.0 | 39.0 | 39.0 | | | | Mostly loblolly pine. | 45.10 |
| 37.3 | " | 7½x9 | " | 85 | " | 15,000,000 | 1916 | 12.0 | 55.7 | 55.7 | | | | Mostly loblolly pine. | 45.10 |
| 37.4 | " | 7½x9 | " | 85 | " | 15,000,000 | 1916 | 11.0 | 40.0 | 40.0 | | | | Mostly loblolly pine. | 45.10 |
| 37.5 | None | | " | 60 | Gravel | Medium | 1916 | 10.0 | 0 | 0 | | 94.8% Good | | | 6.11 |
| | | | | | ZINC-CRESOTE. | | | | | | | | | | |
| 37.6 | None | | | | Earth | | 1916 | 21.0 | 100.0 | | | | 15.6 | | 7.10 |
| 37.7 | C.S. No. 37 | | Cut | | Gravel | | 1916 | 9.0 | 83.2 | | | | | | 7.10 |
| 37.8 | I.&W. | | " | | " | | 1916 | 10.0 | 25.9 | | | | | | 7.10 7.10 |
| | | | | | ZINC-TANNIN—(WELLHOUSE). | | | | | | | | | | |
| 38.1 | Servis | | Cut | 70 | Gravel | | 1916 | 19.0 | 76.0 | | | | | Began to fail 1907. | 16.10 |
| 38.2 | | | " | 70 | " | | 1916 | 19.0 | 70.0 | | | | | " " " 1904. | 16.10 |
| 38.3 | | | " | 70 | " | | 1916 | 19.0 | 94.0 | | | | | " " " 1907. | 16.10 |

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**Cross-Tie Records—Service Tests—*(Continued).***

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | PINE | —(Western | Yellow). | | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 39.1 | 7x8x8 | 94% Sawed | Seasoned 6-9 mos. | 50 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.3 |
| 39.2 | 7x8x8 | 98% Sawed | Seasoned 6-9 mos. | 52 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | 2° Curve | 0.30 |
| 39.3 | 7x8x8 | 98% Sawed | Seasoned 6-9 mos. | 84 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | Tang. | 0.40 |
| 39.4 | 7x8x8 | 96% Sawed | Seasoned 6-9 mos. | 66 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | 1° Curve | 0.36 |
| 39.5 | 7x8x8 | 97% Sawed | Seasoned 6-9 mos. | 157 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | 1° Curve | 0.36 |
| | | | | | | | UNTRE | ATED. | | | | | |
| | | | | | | (See Ta | marack Index | Nos. 6.5-6.7 | ). | | | | |
| 40.1 | | Triang. Sawed | | 1,996 | | | | | 1911 | G.N. | Butte Div. | 70% Tang. | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| | | | | (See | Spruce | Index | No. 5.1; Ta | marack Inde | x Nos. | 7.6 and | 7.8). | | |
| 41.1 | | | | 6,354 | | | | 0.35-0.40 | 1900-1 | C.B.&Q. | Sidney, Neb. | | |
| 41.2 | | | Seasoned | 3,157 | | | | 0.35-0.40 | 1906 | " | Casper Div. | | |
| 41.3 | Triang. | Sawed | | 1,963 | | | | 0.50 | 1911 | G.N. | Butte Div. | 70% Tang. | |
| 41.4 | Square | " | | 1,327 | | | | 0.50 | 1911 | " | " " | 70% Tang. | |
| 41.5 | | Hewed | | 3,328 | | | | 0.50 | 1911 | " | " " | 70% Tang. | |
| 41.6 | Triang. | Sawed | | 1,912 | | | | 0.75 | 1911 | " | " " | 70% Tang. | |
| 41.7 | Square | " | | 1,367 | | | | 0.75 | 1911 | " | " " | 70% Tang. | |
| 41.8 | 8x12x8 | | | 2,562 | | | | 0.75 | 1907 | " | Hobson, Mont. | 40% Tang. | |
| 41.9 | Triang. | " | " | 2,601 | Mont. | 16 to 30' | | 0.50 | 1902 | " | Conrad, Mont. | Tang. | 0.50-0.60 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—(Continued). | | RESULTS. | | | | | | | | |
| | | | | | PINE—(Wes | tern Yel | low | ). | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 39.1 | N.P.Std. | 7x9 | Cut | 90 | Sand and Gr. | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 39.2 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 39.3 | N.P.Std. | 7x9 | Cut | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 39.4 | " | 7x9 | " | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 39.5 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| | | | | | (S | ee Tamar | ack | Ind | ex No | s. 6. | 5-6.7 | ). | | | |
| 40.1 | Goldie | 6x8½ | Cut | 90 | Gravel | | 1916 | 5.3 | 3.0 | | | Fair | | Many ties checked and soft, 6½x8½ plates at joints. | 40.10 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| | | | | (See | Spruce Index No. | 5.1; Tam | ara | ck I | ndex | Nos. | 7.6 | and 7.8). | | | |
| 41.1 | Partly | | " | 75 | Peatz Gravel | | 1916 | 16.0 | 8.0 | 8.0 | | Good | | Plates on curves. | 5.20 |
| 41.2 | None | | " | 65 | Gravel | | 1916 | 10.0 | 0 | | | " | | Ties cut from dead timber show some decay, others good. | 5.20 |
| 41.3 | Goldie | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ plates at joints. | 40.10 |
| 41.4 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ " " " | 40.10 |
| 41.5 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ " " " | 40.10 |
| 41.6 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ " " " | 40.10 |
| 41.7 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | | | 6½x8½ " " " | 40.10 |
| 41.8 | Glendon | | " | 85 | " | 2,146,500 | 1916 | 9.0 | 1.5 | 1.5 | | | | Contains Douglas fir, pine and spruce. | 40.10 |
| 41.9 | None | | " | 68 | " | 2,150,434 | 1916 | 14.0 | 86.0 | | | Fair | | Contains Douglas fir, pine and spruce, 6½x8½ plates at joints. | 40.10 |

Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | PINE | —(Western | Yellow) | —(*Co* | *ntinued* | ). | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 41.10 | Triang. | Sawed | Seasoned | 2,916 | Mont. | 18 to 33' | | | 1908 | G.N. | Morovia, Ida. | 80% Curve | 0.50 |
| 41.11 | | Slabbed | | 1,066 | | | | | 1911 | " | Butte Div. | 70% Tang. | |
| | | | | | | ZINC C | HLORIDE A | ND CRUD | E OIL. | | | | |
| 42.1 | 7x9x8 | Sawed | Green | 140 | N. Cal. | 21" | Zn. 1.0 Oil 16.25 | Zn. 0.28 Oil 4.75 | 1906 | S.P. | W. Oakland | Tang. | None |
| | | | | | | PINE | —(Yellow | ). | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| | | | | | | (See | Oak Index | Nos. 35.6- | 35.7). | | | | |
| 43.1 | 7x8x8½ | " | Seasoned | 32,256 | South | 21" | | | 1909 | P.S.&N. | New York | 43% Curve | 0.15 |
| | | | | | | | PINUS—( | Excelsea | ). | | | | |
| | | | | | | | POWELLI | ZED. | | | | | |
| 1.1 | | | | 116 | | | | | 1911 | N.W. | India, Ranipur Station | | |
| 1.2 | | | | 108 | | | | | 1911 | O.&R. | India | | |
| 1.3 | | | | 108 | | | | | 1911 | " | " | | |
| | | | | | | | PINUS—( | Longifolia | ). | | | | |
| | | | | | | | POWELLI | ZED. | | | | | |
| 1.1 | | | | 197 | | | | | 1911 | N.W. | India, Ranipur Station | | |

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| Service Conditions—*(Continued)*. | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | PINE—( | Western | Yel | low | ). | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 41.10 | Goldie | 6x8½ | Cut | 90 | Gravel | 6,052,224 000 | 1916 | 13.0 | 96.7 | | | Fair | | Contains Douglas fir, pine and spruce, 6½x8½ plates at joints. | 40.10 |
| 41.11 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 20.0 | 20.0 | | Very Poor | | Contains Douglas fir, pine and spruce, 6½x8½ plates at joints. | 40.10 |
| | | | | | ZINC | CHLORI | DE | AN | D CR | UDE | OIL. | | | | |
| 42.1 | Yes | 8x9 | Cut | 75-90 | Rock | Very Heavy | 1916 | 10.0 | 1.4 | | | | | Removed acct. broken under rail and decay. | 32.11 |
| | | | | | PINE—(Yell | ow). | | | | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| | | | | | (See Oak Index | Nos. 35.6- | 35.7 | ). | | | | | | | |
| 43.1 | Wal-haupter | 6x8½ | Cut | 85 | Gravel & Slag | 4,000,000 | 1916 | 7.0 | 20.0 | 20.0 | | Good | | | 1.761 |
| | | | | | PINUS—(Ex | celsea). | | | | | | | | | |
| | | | | | | PO | WE | LLI | ZED. | | | | | | |
| 1.1 | | | | | | | 1914 | 3.0 | | | | Quite Good | | Considerably better than P. Longifolia. | 46.00 |
| 1.2 | | | | | | | 1915 | 4.0 | 0 | | | Quite Fair | | 3% badly cracked. | 46.00 |
| 1.3 | | | | | | | 1915 | 4.0 | 1.86 | | | Good | | Few cracked. | 46.00 |
| | | | | | PINUS—( | Longifo | lia | ). | | | | | | | |
| | | | | | | PO | WE | LLI | ZED. | | | | | | |
| 1.1 | | | | | | | 1914 | 3.0 | | | | Good | | No ant attack. | 46.00 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | PINE | -(Southern | Yellow). | | | | | |
| | | | | | | | CREO | SOTE. | | | | | |
| 22.2 | 8x7x9 | Sawed | | 6,000 | | | | 10.00 | 1894 | N.Y.N H.&H. | Fanhaven Tunnel | | |
| 33.2 | 7x9x8 | " | | 500 | | | | | 1906 | " | " " | | |
| 33.3 | 7x9x8 | " | | 200 | | | | | 1907 | " | " " | | |
| | | | | | | CREO | SOTE—(BE | THELL). | | | | | |
| 34.1 | 7x9x8½ | " | Green | 1,274 | Miss. | 22" | 44.6 | 12.0 | 1907 | L.&N. | Miss. | 30' Curve | 0.44 |
| 34.2 | 6x10x8 | | | 868 | | | Gal. 4.42 | Gal. 1.326 | 1909 | G.H.& S.A. | Bay View | | |
| 34.3 | 7x9x9 | " | | 285 | | | | 12.00 | 1906 | " | Lafayette | | |
| 34.4 | | | | 205 | | | | | 1906 | " | Salix | | |
| 34.5 | 6x10x8 | | | 1,963 | | 18 to 33' | | 1.30 | 1911 | " | Olivier | | |
| 34.6 | 6x10x8 | | | 849 | | 16 to 33' | | 1.30 | 1911 | " | " | | |
| 34.7 | 6x10x8 | | | 295 | | 14 to 30' | | 1.30 | 1911 | " | " | | |
| 34.8 | 6x10x8 | | | 731 | | 16 to 33' | | 1.30 | 1911 | " | " | | |
| 34.9 | 7x9x9 | " | | 205 | | | | | 1907 | " | Salix | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 35.1 | | | Seasoned | 99 | | | Gal. 3.5 | | 1915 | D.&L.W. | Paterson, N. J. | | |
| 35.2 | 7x9x8½ | | " | 37 | | | Gal. 3.5 | | 1915 | " | Dover, N. J. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 36.1 | | " | Seasoned | 173 | | | | 4.56 | 1905 | A.T.& S.F. | Chillicothe, Ill. | | |
| 36.2 | | " | " | 304 | | | | 4.56 | 1905 | " | Marcelline, Mo. | | |
| 36.3 | | " | " | 44 | | | | 4.56 | 1905 | " | Sutton, Kan. | | |
| 36.4 | | " | " | 190 | | | | 4.56 | 1904 | " | Ponca City, Okla. | | |
| 36.5 | | Sawed | " | 275 | | | | 3.93 | 1904 | " | Bliss, Okla. | | |
| 36.6 | | " | " | 366 | | | | 3.93 | 1904 | " | Perry, Okla. | | |
| 36.7 | | Hewed | " | 27 | | | | 4.56 | 1904 | " | Perry, Okla. | | |
| 36.8 | | Sawed | " | 384 | | | | 3.93 | 1905 | " | Garnet, Kan. | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PINE—(Southern Yellow). | | | | | | | | | | |
| | | | | | | | CR | EOS | OTE. | | | | | | |
| 33.1 | None | | Cut | 100 | Stone | Heavy | 1916 | 22.0 | 99.6 | | | | | 24 ties still in track. | 38.10 |
| 33.2 | | | " | 100 | " | " | 1916 | 10.0 | 0 | | | | | | 38.10 |
| 33.3 | | | " | 100 | " | | 1916 | 9.0 | 0 | | | | | | 38.10 |
| | | | | | | CREOSOTE—(BETHELL). | | | | | | | | | |
| 34.1 | Goldie | 7x6 | Cut | 70 | Slag | | 1916 | 9.0 | 0.24 | 0.16 | 0.08 | Fair | | Includes shortleaf and long. Joint plate 8x6. | 18.00 |
| 34.2 | Clark | 8½x10 | Screw | 80 | Gravel | | 1916 | 6.8 | 0 | | | Good | | | 7.10 |
| 34.3 | I. & W. | | Cut | | Gravel | | 1916 | 10.0 | 34.3 | | | | | | 7.10 |
| 34.4 | | | | | | | 1916 | 10.0 | 4.8 | | | | | | 7.10 |
| 34.5 | Clark | | Screw | 90 | " | | 1916 | 5.0 | 0 | | | | | 9 ties slightly decayed. | 7.10 |
| 34.6 | " | 8½x10 | " | 90 | " | | 1916 | 5.0 | 0 | | | | | 7 ties slightly decayed. | 7.10 |
| 34.7 | " | 8½x10 | " | 90 | " | | 1916 | 5.0 | 0 | | | | | 4 ties slightly decayed. | 7.10 |
| 34.8 | " | 8½x10 | " | 90 | " | | 1916 | 5.0 | 0.55 | | | | | 2 ties slightly decayed. | 7.10 |
| 34.9 | Yes | | Cut | | " | | 1916 | 9.0 | 4.8 | | | | | | 7.10 |
| | | | | | | CREOSOTE—(LOW RY). | | | | | | | | | |
| 35.1 | Hook Shoulder | | S. & B. | 101 | Stone | | 1916 | 1.0 | 0 | | | | | | 44.10 |
| 35.2 | " | | " | 101 | " | | 1916 | 1.0 | 0 | | | | | | 44.10 |
| | | | | | | CREOSOTE—(RUEPING). | | | | | | | | | |
| 36.1 | Yes | 6x8 | Cut | 85 | Gravel | 10,000,000 | 1916 | 11.0 | 4.0 | | | | | Loblolly pine predominates | 45.10 |
| 36.2 | " | 6x8 | " | 85 | " | 10,000,000 | 1916 | 11.0 | 38.8 | 2.6 | 5.9 | | | Loblolly pine predominates 30.3% removed for switch, etc. | 45.10 |
| 36.3 | " | 6x8 | " | 85 | Slag | 6,500,000 | 1916 | 11.0 | 9.1 | | 9.1 | | | Loblolly pine predominates | 45.10 |
| 36.4 | " | 7½x9 | " | 85 | Rock | 2,500,000 | 1916 | 12.0 | 4.2 | | 4.2 | | | " " " | 45.10 |
| 36.5 | " | 7½x9 | " | 90 | " | 2,500,000 | 1916 | 12.0 | 4.0 | | 4.0 | | | " " " | 45.10 |
| 36.6 | " | 7½x9 | " | 90 | " | 2,500,000 | 1916 | 12.0 | 0 | | | | | " " " | 45.10 |
| 36.7 | " | 7½x9 | " | 90 | " | 2,500,000 | 1916 | 12.0 | 0 | | | | | " " " | 45.10 |
| 36.8 | " | 7½x9 | " | 90 | " | 4,800,000 | 1916 | 11.0 | 10.4 | 10.4 | | | | " " " | 45.10 |



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## Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | PINE | -(Southern | Yellow) | —(*C* | *ontinued* | ). | | |
| 36.9 | | Sawed | Seasoned | 572 | | | | 3.93 | 1905 | A.T.& S.F. | Argonia, Kan. | | |
| 36.10 | | " | " | 54,621 | | | | 5.00 | 1910 | " | Hutch. Cut-Off | | |
| 36.11 | | | " | 9,436 | | | | 5.00 | 1910 | " | " " | | |
| 36.12 | 6x8x8 | Hewed | " | 24,238 | | | | less than 5.00 | 1906 | " | Ottowa Cut-Off | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 37.1 | | Hewed | Seasoned | 9,251 | | | | 0.58 | 1905 | A.T.& S.F. | Newton, Kan. | | |
| 37.2 | | " | " | 6,357 | | | | 0.58 | 1904 | " | " " | | |
| 37.3 | | Sawed | " | 2,517 | | | | 0.52 | 1904 | " | " " | | |
| 37.4 | | " | " | 40 | | | | 0.52 | 1905 | " | " " | | |
| 37.5 | 6x8x8 | " | " | 496 | Texas | 19 to Rl. | 1.50 | 0.50 | 1906 | C.M.& St.P. | Okaton, S. D. | 53.8% Cv. | |
| | | | | | | | ZINC-CREO | SOTE. | | | | | |
| 37.6 | | | | 1,095 | | | | | 1895 | G.H.& S.A. | Watkins, C. O. | | |
| 37.7 | 7x9x9 | Hewed | | 433 | | | Zn. 1.01 C. 17.7 | | 1907 | " | Salix | | |
| 37.8 | 7x9x9 | " | | 476 | | | Zn. 1.01 C. 17.7 | | 1906 | " | Lafayette | | |
| | | | | | | ZINC- | TANNIN—( | WELLHO | USE). | | | | |
| 38.1 | | " | Seasoned | 25 | | | | | 1897 | N.S. | Norfolk Div. | 2° Curve | |
| 38.2 | | Sawed | " | 100 | | | | | 1897 | " | " " | Tang. | |
| 38.3 | | Hewed | " | 100 | | | | | 1897 | " | " " | " | |

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| Index No. | Service Conditions—(Continued). Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PINE—(Sout | hern Ye | llow | )— | (Con | tin | ued | ). | | | |
| 36.9 | Yes | 7½x9 | Cut | 90 | Rock | 5,130,000 | 1916 | 11.0 | 11.2 | 0.7 | 10.5 | | | Loblolly pine predominates | 45.10 |
| 36.10 | " | 7½x9 | Screw | 90 | " | 4,900,000 | 1916 | 6.0 | 0.14 | | 0.01 | | | " " " 1.3% burned. | 45.10 |
| 36.11 | " | 7½x9 | " | 90 | " | 4,900,000 | 1916 | 6.0 | 0 | | | | | Loblolly pine predominates | 45.10 |
| 36.12 | " | 6x8 7½x9 | Cut | 85 | " | 14,327,700 | 1916 | 10.0 | 0.03 | | | | | " " " 90 lb. rail laid 1914 removed acct. burned. | 45.10 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 37.1 | Yes | 7½x9 | Cut | 85 | Rock | 15,000,000 | 1916 | 11.0 | 39.1 | 32.6 | | | | 6½% removed for experimental purposes. Mostly loblolly pine. | 45.10 |
| 37.2 | " | 7½x9 | " | 85 | " | 15,000,000 | 1916 | 12.0 | 39.0 | 39.0 | | | | Mostly loblolly pine. | 45.10 |
| 37.3 | " | 7½x9 | " | 85 | " | 15,000,000 | 1916 | 12.0 | 55.7 | 55.7 | | | | Mostly loblolly pine. | 45.10 |
| 37.4 | " | 7½x9 | " | 85 | " | 15,000,000 | 1916 | 11.0 | 40.0 | 40.0 | | | | Mostly loblolly pine. | 45.10 |
| 37.5 | None | | " | 60 | Gravel | Medium | 1916 | 10.0 | 0 | 0 | | 94.8% Good | | | 6.11 |
| | | | | | | ZINC- | CRE | OS | OTE. | | | | | | |
| 37.6 | None | | | | Earth | | 1916 | 21.0 | 100.0 | | | | 15.6 | | 7.10 |
| 37.7 | C.S. No. 37 | | Cut | | Gravel | | 1916 | 9.0 | 83.2 | | | | | | 7.10 |
| 37.8 | I.&W. | | " | | " | | 1916 | 10.0 | 25.9 | | | | | | 7.10 7.10 |
| | | | | | ZINC-TANNIN | —(WEL | LH | OU | SE). | | | | | | |
| 38.1 | Servis | | Cut | 70 | Gravel | | 1916 | 19.0 | 76.0 | | | | | Began to fail 1907. | 16.10 |
| 38.2 | | | " | 70 | " | | 1916 | 19.0 | 70.0 | | | | | " " " 1904. | 16.10 |
| 38.3 | | | " | 70 | " | | 1916 | 19.0 | 94.0 | | | | | " " " 1907. | 16.10 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | PINE —(Western Yellow). | | | | | | | |
| | | | | | | CR EOSOTE—( LOWRY.) | | | | | | | |
| 39.1 | 7x8x8 | 94% Sawed | Seasoned 6-9 mos. | 50 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | N.P. | Thompson Falls, Mont. | 2° Curve | 0.3 |
| 39.2 | 7x8x8 | 98% Sawed | Seasoned 6-9 mos. | 52 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | 2° Curve | 0.30 |
| 39.3 | 7x8x8 | 98% Sawed | Seasoned 6-9 mos. | 84 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | Tang. | 0.40 |
| 39.4 | 7x8x8 | 96% Sawed | Seasoned 6-9 mos. | 66 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | 1° Curve | 0.36 |
| 39.5 | 7x8x8 | 97% Sawed | Seasoned 6-9 mos. | 157 | Mont. & Ida. | 19 to 33 | 22.60 | 7.26 | 1915 | " | " " | 1° Curve | 0.36 |
| | | | | | | UNTRE ATED. | | | | | | | |
| | | | | | | (See Ta marack Index Nos. 6.5-6.7 ). | | | | | | | |
| 40.1 | | Triang. Sawed | | 1,996 | | | | | 1911 | G.N. | Butte Div. | 70% Tang. | |
| | | | | | | ZINC CHLORIDE —(BURNETT). | | | | | | | |
| | | | | (See | Spruce | Index No. 5.1; Ta marack Index Nos. 7.6 and 7.8). | | | | | | | |
| 41.1 | | | | 6,354 | | | | 0.35-0.40 | 1900-1 | C.B.&Q. | Sidney, Neb. | | |
| 41.2 | | | Seasoned | 3,157 | | | | 0.35-0.40 | 1906 | " | Casper Div. | | |
| 41.3 | Triang. | Sawed | | 1,963 | | | | 0.50 | 1911 | G.N. | Butte Div. | 70% Tang. | |
| 41.4 | Square | " | | 1,327 | | | | 0.50 | 1911 | " | " " | 70% Tang. | |
| 41.5 | | Hewed | | 3,328 | | | | 0.50 | 1911 | " | " " | 70% Tang. | |
| 41.6 | Triang. | Sawed | | 1,912 | | | | 0.75 | 1911 | " | " " | 70% Tang. | |
| 41.7 | Square | " | | 1,367 | | | | 0.75 | 1911 | " | " " | 70% Tang. | |
| 41.8 | 8x12x8 | | | 2,562 | | | | 0.75 | 1907 | " | Hobson, Mont. | 40% Tang. | |
| 41.9 | Triang. | " | " | 2,601 | Mont. | 16 to 30' | | 0.50 | 1902 | " | Conrad, Mont. | Tang. | 0.50-0.60 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—(Continued). | | RESULTS. | | | | | | | | |
| | | | | | PINE—(Western Yellow). | | | | | | | | | | |
| | | | | | CREOSOTE—(LOW RY). | | | | | | | | | | |
| 39.1 | N.P.Std. | 7x9 | Cut | 90 | Sand and Gr. | 8,270,506 | 1916 | 1.0 | 0 | | | Good | | | 25.00 |
| 39.2 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 39.3 | N.P.Std. | 7x9 | Cut | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 39.4 | " | 7x9 | " | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| 39.5 | Vignoles bolted to | Rail Ch | airs | 90 | " | 8,270,506 | 1916 | 1.0 | 0 | | | " | | | 25.00 |
| | | | | | | UNTREATED. | | | | | | | | | |
| | | | | | (See Tamarack Index Nos. 5.1; 5.6.7). | | | | | | | | | | |
| 40.1 | Goldie | 6x8½ | Cut | 90 | Gravel | | 1916 | 5.3 | 3.0 | | | Fair | | Many ties checked and soft, 6½x8½ plates at joints. | 40.10 |
| | | | | | ZINC CHLORIDE—(BURNETT). | | | | | | | | | | |
| | | | | | (See Spruce Index Nos. 5.1; Tamarack Index Nos. 7.6 and 7.8). | | | | | | | | | | |
| 41.1 | Partly | | " | 75 | Peatz Gravel | | 1916 | 16.0 | 8.0 | 8.0 | | Good | | Plates on curves. | 5.20 |
| 41.2 | None | | " | 65 | Gravel | | 1916 | 10.0 | 0 | | | " | | Ties cut from dead timber show some decay, others good. | 5.20 |
| 41.3 | Goldie | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ plates at joints. | 40.10 |
| 41.4 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ " " " | 40.10 |
| 41.5 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ " " " | 40.10 |
| 41.6 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | " | | 6½x8½ " " " | 40.10 |
| 41.7 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 0 | | | | | 6½x8½ " " " | 40.10 |
| 41.8 | Glendon | | " | 85 | " | 2,146,500 | 1916 | 9.0 | 1.5 | 1.5 | | | | Contains Douglas fir, pine and spruce. | 40.10 |
| 41.9 | None | | " | 68 | " | 2,150,434 | 1916 | 14.0 | 86.0 | | | Fair | | Contains Douglas fir, pine and spruce, 6½x8½ plates at joints. | 40.10 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | PINE | —(Western | Yellow) | —(*Co* | *ntinued* | ). | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 41.10 | Triang. | Sawed | Seasoned | 2,916 | Mont. | 18 to 33′ | | | 1908 | G.N. | Morovia, Ida. | 80% Curve | 0.50 |
| 41.11 | | Slabbed | | 1,066 | | | | | 1911 | " | Butte Div. | 70% Tang. | |
| | | | | | | ZINC C | HLORIDE A | ND CRUD | E OIL. | | | | |
| 42.1 | 7x9x8 | Sawed | Green | 140 | N. Cal. | 21" | Zn. 1.0 Oil 16.25 | Zn. 0.28 Oil 4.75 | 1906 | S.P. | W. Oakland | Tang. | None |
| | | | | | | PINE | —(Yellow | ). | | | | | |
| | | | | | | | UNTRE | ATED. | | | | | |
| | | | | | | (See | Oak Index | Nos. 35.6- | 35.7). | | | | |
| 43.1 | 7x8x8½ | " | Seasoned | 32,256 | South | 21" | | | 1909 | P.S.&N. | New York | 43% Curve | 0.15 |
| | | | | | | | PINUS—( | Excelsea | ). | | | | |
| | | | | | | | POWELLI | ZED. | | | | | |
| 1.1 | | | | 116 | | | | | 1911 | N.W. | India, Ranipur Station | | |
| 1.2 | | | | 108 | | | | | 1911 | O.&R. | India | | |
| 1.3 | | | | 108 | | | | | 1911 | " | " | | |
| | | | | | | | PINUS—( | Longifolia | ). | | | | |
| | | | | | | | POWELLI | ZED. | | | | | |
| 1.1 | | | | 197 | | | | | 1911 | N.W. | India, Ranipur Station | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | PINE—( | Western | Yel | low | ). | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 41.10 | Goldie | 6x8½ | Cut | 90 | Gravel | 6,052,224 000 | 1916 | 13.0 | 96.7 | | | Fair | | Contains Douglas fir, pine and spruce, 6½x8½ plates at joints. | 40.10 |
| 41.11 | " | 6x8½ | " | 90 | " | | 1916 | 5.3 | 20.0 | 20.0 | | Very Poor | | Contains Douglas fir, pine and spruce, 6½x8½ plates at joints. | 40.10 |
| | | | | | ZINC | CHLORI | DE | AN | D CR | UDE | OIL. | | | | |
| 42.1 | Yes | 8x9 | Cut | 75-90 | Rock | Very Heavy | 1916 | 10.0 | 1.4 | | | | | Removed acct. broken under rail and decay. | 32.11 |
| | | | | | PINE—(Yell | ow). | | | | | | | | | |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| | | | | | (See Oak Index | Nos. 35.6- | 35.7 | ). | | | | | | | |
| 43.1 | Wal-haupter | 6x8½ | Cut | 85 | Gravel & Slag | 4,000,000 | 1916 | 7.0 | 20.0 | 20.0 | | Good | | | 1.761 |
| | | | | | PINUS—(Ex | celsea). | | | | | | | | | |
| | | | | | | PO | WE | LLI | ZED. | | | | | | |
| 1.1 | | | | | | | 1914 | 3.0 | | | | Quite Good | | Considerably better than P. Longifolia. | 46.00 |
| 1.2 | | | | | | | 1915 | 4.0 | 0 | | | Quite Fair | | 3% badly cracked. | 46.00 |
| 1.3 | | | | | | | 1915 | 4.0 | 1.86 | | | Good | | Few cracked. | 46.00 |
| | | | | | PINUS—( | Longifo | lia | ). | | | | | | | |
| | | | | | | PO | WE | LLI | ZED. | | | | | | |
| 1.1 | | | | | | | 1914 | 3.0 | | | | Good | | No ant attack. | 46.00 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS. | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | PINUS—(Longifolia)—(*Continued*). | | | | | | | |
| | | | | | | | POWELLIZED. | | | | | | |
| 1.2 | | | | 152 | | | | | 1911 | O.&R. | India | | |
| 1.3 | | | | 152 | | | | | 1911 | " | " | | |
| | | | | | | | POPLAR. | | | | | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 30 | | | | | 1910 | C.B.&Q. | Hanover, Ill. | | |
| 1.2 | | | | 20 | | | | | 1910 | " | Blanding, Ill. | | |
| 1.3 | | | | 30 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | | UNTREATED. | | | | | | |
| 2.1 | | | | 55 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 2.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 2.3 | | | | 30 | | | | | 1909 | " | Lines West | | |
| 2.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETT). | | | | | |
| 3.1 | | | | 50 | | | | 0.50 | 1910 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 30 | | | | 0.50 | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 4.1 | | | | 366 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 24 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 4.3 | | | | 208 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 4.4 | | | | 46 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | | | | | PINUS—(Lo | ngifolia | )— | (C | ontin | ued | ). | | | | |
| | | | | | POWELLIZED. | | | | | | | | | | |
| 1.2 | | | | | | | 1915 | 4.0 | 2.60 | | | Good | | Some crocked and cut from heart. | 46.00 |
| 1.3 | | | | | | | 1915 | 4.0 | 0 | | | | | 7.2% badly split. 2.6% warped, ugly looking ties but serviceable. | 46.00 |
| | | | | | POPLAR. | | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 1.2 | Yes | | " | 90 | " | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 1.3 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 2.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 90.9 | | | | | | 5.20 |
| 2.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 68.0 | | | | | | 5.20 |
| 2.3 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 96.7 | | | | | | 5.20 |
| 2.4 | " | | " | | Lyons Stone | | 1916 | 6.0 | 80.0 | | | | | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | ). | | | | |
| 3.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 4.0 | | | | | | 5.20 |
| 3.2 | Yes | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 7.1 | | | | | | 5.20 |
| 4.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 4.3 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 5.8 | | | | | | 5.20 |
| 4.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | SASS | AFRAS. | | | | | |
| 1.1 | 6x8x8 | Hewed | Seasoned | 15 | Ind. | CR 20" | EOSOTE—( | LOWRY.) 3.10 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | 0.5 |
| | | | | | | | SPRUCE— | (Eastern | and | Western | ). | | |
| 1.1 | | | | 525 | West. U. S. | C | REOSOTE | —(BOILI 12.00 | NG). 1911 | N.P. | Seattle, Wash. | | |
| 2.1 | | | | 310 | West. U. S. | CR | EOSOTE—( | RUEPING 12.00 | ). 1911 | N.P. | Seattle, Wash. | | |
| 3.1 | | | | 57 | West. U. S. | CRE | OSOTE AND | CRUDE O 12.00 | IL. 1911 | N.P. | Seattle, Wash. | | |
| 4.1 | 6x8x8 | | Seasoned 6-8 mos. | 25 | East. U. S. | MERC 18 to Rl. | URIC CHLO | RIDE—(K | YAN). 1911 | C.M.& St.P. | Hartford, Wis. | Tang. | 0 |
| | | | | | | (See | UNTRE Tamarack Ind | ATED. ex Nos. 6.5 | -6.7). | | | | |

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| Service Conditions—*(Continued)*. | | | | | | | Results. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| 1.1 | Economy | 7 | Cut | 90 | SASSAFRAS Gravel | —(*Continued*). CREOSOTE 5,297,567 | 1916 | 2.0 | LOW 0 | RY). | | Excellent | | Treated July, 1913; set June, 1914. | 51.00 |
| 1.1 | | | | | SPRUCE—( | Eastern CREOSOTE | and TE 1915 | We —( 4.0 | stern BOIL 0 | ). ING | ). | | | | 19.00 |
| 2.1 | | | | | | CREOSOTE | TE 1915 | —(R 4.0 | UEP 0 | ING). | | | | | 19.00 |
| 3.1 | | | | | CR | EOSOTE | AN 1915 | D C 4.0 | RUD 0 | E OI | L. | | | Crude Oil, 80% Creosote, 20%. | 19.00 |
| 4.1 | 50% none 50% Economy | 7½x9 | 50% C. 50% S. | 90 | MER Gravel | CURIC Heavy | CH 1916 | LO 5.0 | RIDE 0 | —(K | YAN | ). 100% Good | | | 27.00 |
| | | | | | (See Tamarack | UN Index | TR Nos. | EAT 6.5- | ED. 6.7). | | | | | | |



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Cross-Tie Records—Service Tests—*(Continued)*.

| Description of Material. | | | | | | | | | Service Conditions | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption Lbs. Per Tie | Average Absorption Lbs. Cu. Ft. | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | ZINC | SPRUCE CHLORIDE | —(*Continued*). —(BURNETTE). | | | | | |
| 5.1 | | Triang. | | (See Index Nos. 41.8-41.10 and Tamarack, 2,823 | e Pine West. U. S. | | | 0.50 | 1904 | G.N. | 7.6 and 7.8). Columbia Falls, Mont. | Tang. | |
| | | | | | | CR | SYCAMORE. EOSOTE—( | FULL-CEL | L). | | | | |
| 1.1 | | | | 75 | | | | | 1910 | C.B.&Q. | Lines East | | |
| 1.2 | | | | 15 | | | | | 1910 | " | Barr, Colo. | | |
| | | | | | | | UNTREATED. | | | | | | |
| 2.1 | | | | 65 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 2.2 | | | | 25 | | | | | 1910 | " | " " | | |
| 2.3 | | | | 35 | | | | | 1909 | " | Lines West | | |
| 2.4 | | | | 15 | | | | | 1910 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNETTE). | | | | | |
| 3.1 | | | | 75 | | | | 0.50 | 1910 | C.B.&Q. | Lines East | | |
| 3.2 | | | | 15 | | | | 0.50 | 1910 | " | Barr, Colo. | | |
| | | | | | | ZINC- | CREOSOTE | —(CARD). | | | | | |
| 4.1 | | | | 173 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 4.2 | | | | 224 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 4.3 | | | | 91 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 4.4 | | | | 30 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |

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| Indx No. | Service Conditions—*(Continued)*. Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Results. In-spected | Time Ser-vice | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Refer-ence No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SPRUCE—( *Continu* | | *ed* | ). | | | | | | | |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | | ). | | | |
| | | | | | (See Pine Index | Nos. 41.8 | -41. | 10 | and T | amar | ack, 7 | .6 and 7.8). | | | |
| 5.1 | Goldie & G. N. | | 9/16x5½ ⅝x6 | 90 | Gravel | | 1916 | 12.0 | 84.4 | | | | | Includes fir, pine, tamarack. Removed acc. decayed, split and broken. | 40.10 |
| | | | | | SYCAMORE. | | | | | | | | | | |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 1.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 1.3 | | | | | | 5.20 |
| 1.2 | Yes | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 2.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 84.6 | | | | | | 5.20 |
| 2.2 | All | | " | 90 | Gravel | | 1915 | 5.0 | 100.0 | | | | 3.2 | | 5.20 |
| 2.3 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 97.2 | | | | | | 5.20 |
| 2.4 | " | | " | 90 | Lyons Stone | | 1915 | 5.0 | 100.0 | | | | 3.9 | | 5.20 |
| | | | | | ZINC | CHLORI | DE | —( | BURN | ETT | | ). | | | |
| 3.1 | All | | Cut | 90 | Sheridan Gravel | | 1916 | 6.0 | 2.7 | | | | | | 5.20 |
| 3.2 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 6.7 | | | | | Seasoned 1 year after treatment. | 5.20 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| 4.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 9.8 | | | | | | 5.20 |
| 4.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0.9 | | | | | | 5.20 |
| 4.3 | " | | " | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 6.6 | | | | | | 5.20 |
| 4.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | TAMARA | CK. | | | | | |
| | | | | | | CR | EOSOTE—( | BOILING) | | | | | |
| 1.1 | | | | 486 | | | | 12.00 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | CR | EOSOTE—( | FULL-CEL | L). | | | | |
| 2.1 | | | | 85 | | | | 8.05 | 1909 | C.B.&Q. | Lines East | | |
| 2.2 | | | | 20 | | | | 8.05 | 1910 | " | " " | | |
| 2.3 | | | | 14 | | | | 8.05 | 1911 | " | " " | | |
| 2.4 | | | | 46 | | | | 8.05 | 1909 | " | Lines West | | |
| 2.5 | | | | 60 | | | | | 1910 | " | " " | | |
| 3.1 | | | Various Seasoning | 19 | | 19 to 33' | 15.5 | | 1907 | C.&N.W. | Janesville, Wis. | | |
| | | | | | | CR | EOSOTE—( | RUEPING | ). | | | | |
| 4.1 | | | | 504 | | | | 12.00 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | CRE | OSOTE AND | CRUDE O | IL. | | | | |
| 5.1 | | | | 204 | | | | 12.00 | 1911 | N.P. | Seattle, Wash. | | |
| | | | | | | | | UNTRE | ATED. | | | | |
| 6.1 | | | | 85 | | | | | 1909 | C.B.&Q. | Lines East | | |
| 6.2 | | | | 10 | | | | | 1910 | " | " " | | |
| 6.3 | | | | 47 | | | | | 1909 | " | Lines West | | |
| 6.4 | | | | 30 | | | | | 1910 | " | " " | | |
| 6.5 | Sawed 7x9x8 Hewed 7x7x8 | 54% Sawed 46% Hewed | Unseasoned | 2,894 | West. Mont. | 18 to Rl. | | | 1908 | G.N. | Newport, Wash. | 1° 15' Cv. 80% Tang. | 0.40 |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | SERVICE CONDITIONS—(Continued). | | RESULTS. | | | | | | | | |
| | | | | | TAMARACK | —(Con | tin | ued | ). | | | | | | |
| | | | | | | CREOSO | TE | —(B | OILI | NG). | | | | | |
| 1.1 | | | | | | 1915 | 4.0 | 0 | | | | | | | 19.00 |
| | | | | | CR | EOSOTE | —( | FUL | L-CE | LL). | | | | | |
| 2.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 2.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 2.3 | Partly | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 2.4 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 2.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| | | | | | CRE | OSOTE | —( | OP | EN-T | ANK | ). | | | | |
| 3.1 | Wal-haupter | | | 90 | Gravel | | 1916 | 8.5 | 0 | | | 100%Good | | | 26.00 |
| | | | | | | CREOSO | TE | —(R | UEP | ING). | | | | | |
| 4.1 | | | | | | | 1915 | 4.0 | 0 | | | | | | 19.00 |
| | | | | | CR | EOSOTE | AN | D C | RUD | E OI | L. | | | | |
| 5.1 | | | | | | | 1915 | 4.0 | 0 | | | | | 80% Crude Oil 20% Creosote. | 19.00 |
| | | | | | | UN | TR | EAT | ED. | | | | | | |
| 6.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1915 | 6.0 | 100.0 | | | | 4.7 | All out 6 years. | 5.20 |
| 6.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 60.0 | | | | | | 5.20 |
| 6.3 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 100.0 | | | | 4.9 | All out 7 years. | 5.20 |
| 6.4 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 66.7 | | | | | | 5.20 |
| 6.5 | G.N. No. 58 | 6x8½ | ⅝x6 | 90 | Lyons Stone | 6,052,224 | 1916 | 8.0 | 82.2 | | | Fair Gravel | | Includes pine, spruce 112,093,- 1916 8.0 82.2 and fir. Removed acct. decay and split. | 40.10 |



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Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | TAMARA | CK—(*Co* | *ntinu* | *ed*). | | | |
| 6.6 | 7x8x8 | | | 2,989 | | | | | 1908 | " | Judith, Gap, Mont. | 60% Tang. 40% Curve | |
| 6.7 | 7x9x8 | Sawed | Seasoned | 2,916 | West. Mont. | 18 to Rl. | | | 1908 | " | Rimrock, Mont. | 3° 30′ Cv. 10% Tang. | 0.50 |
| 6.8 | 7x8x8 | | | 1,575 | | | | | 1904 | " | Mohall, N. D. | Tang. | |
| 6.9 | 6x7x8 | Hewed | " | 2,824 | North. Minn. | 16 to 30 ft. Rl. | | | 1904 | " | " | 1° Curve 98% Tang. | 0.3 |
| 6.10 | | " | Peeled and seasoned 23 mos | 25 | | 19 to 33′ | | | 1907 | C.&N.W. | Janesville, Wis. | | |
| 6.11 | | | Peeled and seasoned 35 mos. | 20 | | 19 to 33′ | | | 1907 | " | " " | | |
| 6.12 | | | Unpeeled and seasoned 11 m. | 62 | | 19 to 33′ | | | 1907 | " | " " | | |
| | | | | | | ZINC | CHLORIDE | —(BURNE | TT). | | | | |
| 7.1 | | Triang. | | 1,320 | | | | 0.45-0.50 | 1904 | C.B.&Q. | Lines West | | |
| 7.2 | | | | 85 | | | | 0.50 | 1909 | " | Lines East | | |
| 7.3 | | | | 21 | | | | 0.50 | 1910 | " | " " | | |
| 7.4 | | | | 45 | | | | 0.50 | 1909 | " | Lines West | | |
| 7.5 | | | | 61 | | | | 0.50 | 1910 | " | " " | | |
| 7.6 | 7x9x8 | Sawed | Seasoned | 2,848 | West. Mont. | 16 to 30 ft. Rl. | | 0.50 | 1903 | G.N. | Granville, N.D. | Tang. | 0.40 |
| 7.7 | | | | 2,580 | | | | 0.50 | 1903 | " | Glenburn, N. D. | " | |
| 7.8 | | | | 2,708 | | | | 0.50 | 1904 | " | White Fish, Mont. | " | |
| 7.9 | | | Peeled and unpeeled seasoned 3-7 m. | 125 | | 19 to 33′ | | 0.510 | 1907 | C.&N.W. | Janesville, Wis. | | |
| 7.10 | | | Peeled and seasoned 10 mos. | 125 | | 19 to 33′ | | 0.508 | 1907 | " | " " | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | In-spected | Time Service | Re-moved % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TAMARACK —(*Continued*). | | | | | | | | | | |
| 6.6 | No. 204 Goldie | | 9/16x 5½ | 85 | Gravel | 2,146,500 | 1916 | 8.0 | 35.7 | 35.7 | | | | No. 204 tie plates on tangent Goldie on curves. Includes pine, spruce and fir. | 40.10 |
| 6.7 | G.N. No. 58 | 6x8½ | ⅝x6 | 90 | " | 2,146,500 | 1916 | 8.0 | 61.5 | 61.5 | | Fair | | Includes pine, spruce and fir. | 40.10 |
| 6.8 | None | | 9/16x 5½ | 68 | " | 315,650 | 1916 | 12.0 | 59.2 | 59.2 | | | | | 40.10 |
| 6.9 | " | | Cut | 68 | Gr., Cin. Patches | 315,650 | 1916 | 12.0 | 52.7 | 52.7 | | " | | Includes cedar. | 40.10 |
| 6.10 | " | | " | 90 | Gravel | Light | 1916 | 8.5 | 72.0 | | | | | 28% decayed and partly decayed. | 26.00 |
| 6.11 | " | | " | 90 | " | " | 1916 | 8.5 | 95.0 | | | | | 5% Decayed. | 26.00 |
| 6.12 | " | | " | 90 | " | " | 1916 | 8.5 | 100.0 | | | | 6.5 | All out 8.5 years. | 26.00 |
| | | | | | ZINC CHLORIDE —(BURNETTE). | | | | | | | | | | |
| | | | | | (See Pine Index | Nos. 41.8 | -41 | 10 a | nd Sp | ruce | Index | No. 5.1). | | | |
| 7.1 | | | | 85 | Rock | | 1915 | 11.3 | 72.0 | | | " | | | 5.20 |
| 7.2 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 1.2 | | | | | | 5.20 |
| 7.3 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 7.4 | Yes | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 7.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 1.6 | | | | | | 5.20 |
| 7.6 | None | | 9/16x 5½ | 60 | Cin.,Gravel | 315,650 | 1916 | 13.0 | 17.0 | 17.0 | | " | | Includes pine, spruce and fir. | 40.10 |
| 7.7 | " | | 9/16x 5½ | 60 | " | 315,650 | 1916 | 13.0 | 9.8 | 9.8 | | | | | 40.10 |
| 7.8 | Goldie G. N. 58 | | 9/16x 5½ | 90 | Gravel | | 1916 | 12.0 | 76.7 | | | | | Includes pine, spruce and fir. Removed acct. decayed, split and broken. | 40.10 |
| 7.9 | Sellers | | Screw | 90 | " | Light | 1916 | 8.5 | 0 | | | 99.2% Good | | 0.8% partly decayed. | 26.00 |
| 7.10 | " | | Cut | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good. | | | 26.00 |

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Cross-Tie Records—Service Tests—(*Continued*).

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | TAMARACK—(*Continued*). | | | | | | |
| 7.11 | | | Peeled and unpeeled seasoned 3-7 mos. | | | 19 to 33′ | | 0.508 | 1907 | C.&N.W. | Janesville, Wis. | | |
| 7.12 | | | Peeled, seasoned 10 mos. | 13 | | 19 to 33′ | | 0.308 | 1907 | " | " " | | |
| | | | | | | ZINC-CREOSOTE—(CARD). | | | | | | | |
| | | | | | | (See Hemlock, Ind ex No. 5.5). | | | | | | | |
| 8.1 | | | | 513 | | | | Zn. 0.50 Cre. 3.00 | 1909 | C.B.&Q. | Lines East | | |
| 8.2 | | | | 298 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| 8.3 | | | | 39 | | | | Zn. 0.50 Cre. 3.00 | 1911 | " | " " | | |
| 8.4 | | | | 284 | | | | Zn. 0.50 Cre. 3.00 | 1909 | " | Lines West | | |
| 8.5 | | | | 211 | | | | Zn. 0.50 Cre. 3.00 | 1910 | " | " " | | |
| | | | | | | ZINC AND CREOSOTE OIL. | | | | | | | |
| 9.1 | | | | 2 | | | | | 1911 | C.B.&Q. | Baders, Ill. | | |
| | | | | | | ZINC-TANNIN—(WELLHOUSE). | | | | | | | |
| 10.1 | | | | 544,000 | | | | Z. C. .443 Gel. .072 Tan. .086 | 1906-07 | C.&N.W. | Various | | |
| 10.2 | 6x8x8 | | Seasoned | 46,800 | | 22″ | | Z. C. .443 Gel. .072 Tan. .086 | 1905 | " | Maribel, Wis. | Tang. | |
| 10.3 | 6x8x8 | | | 76,000 | | 22″ | | Z. C. .443 Gel. .072 Tan. .086 | 1905 | " | Laona, Wis. | 2% Curve 98% Tang. | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Condition Present | Yrs. Avg. | | No. Refer- |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TAMARACK | —(*Con* | *tin* | *ued* | ). | | | | | | |
| 7.11 | Wal-haupter | | Cut | 90 | Gravel | Light | 1916 | 8.5 | 0 | | | 97.6% Good | | 2.4% partly decayed. | 26.00 |
| 7.12 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 92.3% Good | | 7.7% partly decayed. | 26.00 |
| | | | | | ZINC-CREOSO | TE—(C | AR | D). | | | | | | | |
| | | | | | (See Hem | lock, | Ind | ex No. | 5.5). | | | | | | |
| 8.1 | Partly | | Cut | 75-85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0.6 | | | | | | 5.20 |
| 8.2 | All | | " | 90 | Gravel | | 1916 | 6.0 | 0 | | | | | | 5.20 |
| 8.3 | Yes | | " | 75 | " | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| 8.4 | " | | " | 85-90 | Cin., Gr., Bt. Cl. | | 1916 | 7.0 | 0 | | | | | | 5.20 |
| 8.5 | " | | " | 90 | Lyons Stone | | 1916 | 6.0 | 1.0 | | | | | | 5.20 |
| | | | | | | ZINC A | ND | CR | UDE | OIL. | | | | | |
| 9.1 | Yes | | Cut | 75 | Gravel | | 1916 | 5.0 | 0 | | | | | No tie-plates under joints. | 5.20 |
| | | | | | ZINC-TANNIN | —(WEL | LH | OU | SE). | | | | | | |
| 10.1 | | | | | | | 1916 | 9.0 | 12.0 | | | | | Includes hemlock. | 48.00 |
| 10.2 | None | | Cut | 72 | Gravel | | 1916 | 11.0 | 16.1 | | | Fair | | Includes hemlock. | 48.00 |
| 10.3 | Wal-haupter | | " | 74 | " | | 1916 | 11.0 | 1.6 | | | | | Tie-plates on curves only. Includes hemlock. | 48.00 |

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**Cross-Tie Records—Service Tests—*(Continued)*.**

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | TAMARACK—(*Continued*). | | | | | | |
| 10.4 | 6x8x8 | | | 17,622 | | | | Z. C. .443<br>Gel. .072<br>Tan. .086 | 1904 | C.&N.W. | Peninsula Div., Wis. & Mich. | | |
| 10.5 | | Hewed | Peeled and seasoned 11 mos. | 125 | | | | 0.423 | 1907 | " | Janesville, Wis. | | |
| 10.6 | | " | Unpeeled seasoned 11 mos. | 41 | | | | 0.440 | 1907 | " | " " | | |
| 10.7 | | " | Unpeeled seasoned 11 mos. | 9 | | | | 0.440 | 1907 | " | " " | | |
| 10.8 | | " | Unpeeled seasoned 11 mos. | 31 | | | | 0.408 | 1907 | " | " " | | |
| 10.9 | | " | Peeled, seasoned 11 mos. | 7 | | | | 0.408 | 1907 | " | " " | | |
| 10.10 | | " | Peeled, seasoned 11 mos. | 125 | | | | 0.428 | 1907 | " | " " | | |
| 10.11 | | " | Unpeeled, seasoned 11 mos. | 50 | | | | 0.436 | 1907 | " | " " | | |
| 10.12 | | " | Peeled, seasoned 11 mos. | 128 | | | | 0.408 | 1907 | " | " " | | |
| 10.13 | | " | Unpeeled, seasoned 11 mos. | 50 | | | | 0.436 | 1907 | " | " " | | |
| 10.14 | | " | Peeled and unpeeled, seasoned 10 mos. | 59 | | | | 0.424 | 1907 | " | " " | | |
| 10.15 | | " | Peeled and unpeeled, seasoned 10 mos. | 58 | | | | 0.376 | 1907 | " | " " | | |
| | | | | | | | TERMINALIS TEMENTOSA. POWELLIZED. | | | | | | |
| 1.1 | | | | 131 | | | | | 1911 | O.&R. | India | | |
| 1.2 | | | | 187 | | | | | 1911 | " | " | | |
| 1.3 | | | | 158 | | | | | 1911 | N.W. | India, Ranipur Station | | |

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| Indx No. | Tie Plates: Kind | Tie Plates: Size In. | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l: Decay % | Cause R'm'v'l: Wear % | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TAMARACK | —(*Con* | *tin* | *ued* | ). | | | | | | |
| 10.4 | | | | | | | 1916 | 12.0 | 37.3 | 23.0 | 9.0 | | | Includes hemlock 5% removed acct. shaky butts. | 48.00 |
| 10.5 | Sellers | | Screw | 90 | Gravel | Light | 1916 | 8.5 | 0 | | | 96.8% Good | | 3.2% partly decayed. | 26.00 |
| 10.6 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 97.6% Good | | 2% partly decayed. 2.4% partly split. | 26.00 |
| 10.7 | Creo. Wood | | " | 90 | " | Light | 1916 | 8.5 | 11.1 | | | 77.8% Good | | 11.1% partly decayed. | 26.00 |
| 10.8 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 93.6% Good | | 3.2% partly decayed. 3.2% partly split. | 26.00 |
| 10.9 | Sellers | | Cut | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 10.10 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 96.8% Good | | 3.2% partly decayed. | 26.00 |
| 10.11 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 10.12 | Wal-haupter | | " | 90 | " | " | 1916 | 8.5 | 0.8 | | | 97.6% Good | | 0.8% partly decayed. 0.8% partly split. | 26.00 |
| 10.13 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 100% Good | | | 26.00 |
| 10.14 | " | | " | 90 | " | " | 1916 | 8.5 | 0 | | | 83% Good | | 15.3% decayed and partly decayed. 1.7% partly split. | 26.00 |
| 10.15 | " | | " | 90 | " | " | 1916 | 8.5 | 1.7 | | | 94.6% Good | | 94.8% Good 3.5% partly decayed. | 26.00 |
| | | | | | TERMINALI | S TEM | EN | TO | SA. | | | | | | |
| | | | | | | PO | WE | LLI | ZED. | | | | | | |
| 1.1 | | | | | | | 1915 | 4.0 | 0 | | | | | 6.1% split, faults in timber. | 46.00 |
| 1.2 | | | | | | | 1915 | 4.0 | 0 | | | 94.8% Good | | 94.8% Good | 26.00 |
| 1.3 | | | | | | | 1914 | 3.0 | 0 | | | " | | No attack by ants. 13% cracked; to be removed. | 46.00 |

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## Cross-Tie Records—Service Tests—*(Continued)*.

| DESCRIPTION OF MATERIAL. | | | | | | | | | SERVICE CONDITIONS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Index No. | Dimensions | Form | Preparation | No. of Ties In Test | Where Grown | Spacing In Track | Average Absorption | | Date Placed | Name of R. R. | Location | Curve or Tangent | Grade Per Cent |
| | | | | | | | Lbs. Per Tie | Lbs. Cu. Ft. | | | | | |
| | | | | | | | WALNUT | —(Black | ). | | | | |
| | | | | | | CR | EOSOTE—( | LOWRY.) | | | | | |
| 1.1 | 6x8x8 | Hewed | Seasoned | 4 | Ind. | 20" | 12.4 | 4.6 | 1914 | C.I.&L. | Lafayette, Ind. | Tang. | .5 |

| SERVICE CONDITIONS—*(Continued)*. | | | | | | | RESULTS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indx No. | Tie Plates | | Kind of Spikes | Wt. of Rail Lbs. | Kind of Ballast | Traffic Tons Per Year | Inspected | Time Service | Removed % | Cause R'm'v'l | | Present Condition | Avg. Life Yrs. | Remarks | Reference No. |
| | Kind | Size In. | | | | | | | | Decay % | Wear % | | | | |
| | | | | | WALNUT—( | Black). | | | | | | | | | |
| | | | | | | CREOSO | TE | —( | LOW | RY). | | | | | |
| 1.1 | Economy | 7 | Cut | 90 | | 5,297,567 | 1916 | 2.0 | 0 | | | Excellent | | Treated July, 1913; set June, 1914. | 51.00 |

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## Reference And Authorities Quoted In Compiling Report.

| Ref. No. | Information Obtained From | Year | Authority |
|---|---|---|---|
| 1.761 | Letters and reports | 1916 | H. S. Wilgus, Eng. M. of W., P. S. & N. Ry. |
| 4.11 | " " " | 1916 | F. J. Angier, Supt. of Timber Preservation, B. & O. Ry. |
| 5.20 | " " " | 1916 | J. H. Waterman, Supt. Timber Preservation, C. B. & Q. Ry. |
| 6.11 | " " " | 1916 | F. S. Pooler, Tie Agent, C. M. & St. P. Ry. |
| 7.10 | " " " | 1916 | E. B. Cushing, Asst. Gen. Mgr., Sunset Central Lines (G. H. & S. A.) |
| 8.10 | " " " | 1916 | L. C. Hartley, Chief Engineer, C. & E. I. R. R. |
| 12.11 | " " " | 1916 | E. H. Bowser, Supt., Timber Dept., Illinois Central Ry. |
| 14.10 | " " " | 1916 | D. C. Moon, Gen. Mgr., N. Y. Central Lines West. |
| 16.10 | " " " | 1916 | J. H. Young, Prest., Norfolk Southern Ry. |
| 17.00 | " " " | 1916 | Geo. L. Pollock, Purchasing Agent, C. & W. I. Ry. |
| 18.00 | " " " | 1916 | John B. Lindsey, Supt. Treating Plants, L. & N. Ry. |
| 19.00 | " " " | 1916 | Lowry Smith, Supt. Tie Treating Plants, Northern Pacific Ry. |
| 20.11 | " " " | 1916 | B. McKeen, Gen. Mgr., Pennsylvania System West. |
| 21.00 | Forest Service Project No. 38 | 1915 | |
| 22.00 | " " " " 41 | 1915 | |
| 24.00 | " " " " 44 | 1916 | |
| 25.00 | " " " " 50 | 1916 | |
| 26.00 | " " " " 51 | 1916 | |
| 27.00 | " " " " 111 | 1916 | |
| 28.00 | Letters and reports | 1916 | S. Murray, Chief Engineer, O. W. R. R. & N. Co. |
| 30.20 | " " " | 1916 | O. C. Steinmayer, Supervisor Timber Preservation, St. L. & S. F. Ry. |
| 32.10 | " " " | 1916 | J. Q. Barlow, Asst. Chief Engineer, W. R. Scott, Asst. Gen. Mgr., Southern Pacific Ry. |
| 34.00 | " " " | 1916 | W. M. Robinson, Valuation Engineer, Georgia R. R. |
| 35.00 | " " " | 1916 | C. D. Purdon, Chief Engineer, St. L. Southwestern Ry. Lines. |

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| Ref. No. | Information Obtained From | Year | Authority |
|---|---|---|---|
| 36.00 | Letters and reports | 1916 | C. F. Ford, Supervisor Tie & Timber Supply, C. R. I. & P. R. R. |
| 38.10 | " " " | 1916 | W. J. Backes, Eng. M. of W., N. Y., N. H. & H. Ry. |
| 40.10 | " " " | 1916 | J. R. W. Davis, Eng. M. of W., Great Northern Ry. |
| 44.10 | " " " | 1916 | C. E. Gosline, Treating Inspector, D. L. & W. Ry. |
| 45.10 | " " " | 1916 | Geo. E. Rex, Mgr. Treating Plants, A. T. & S. F. Ry. |
| 46.00 | " " " | 1916 | R. S. Pearson, Forest Economist, Forest Research Institute and College, Dehra Dun, U. P. India. |
| 47.00 | " " " | 1916 | Curtis Dougherty, Chief Engineer, Queen & Crescent. |
| 48.00 | " " " | 1916 | M. Hughitt, Jr., Vice Pres., C. & N. W. Ry. |
| 49.00 | " " " | 1916 | Wm. A. Fisher, Formerly Supt. Timber Preservation, Atl. C. Line. |
| 50.00 | " " " | 1916 | H. T. Douglas, Jr., Chief Engineer, Chicago and Alton Ry. |
| 51.00 | " " " | 1916 | T. G. Stull, Chief Timber Inspector, C. I. & L. Ry. |

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## SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.*

| Species | Method of Treatment | | Location | Years of Service at Last Inspection | Date of Last Inspection | Total No. of Posts | % Sound | % Partly Decayed Butt | % Partly Decayed Tops | % Decayed Butt | % Decayed Tops | % Removed for Decay | % Not Inspected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ash | Brush | Carbolineum | University Farm, Minn. | 4 | Nov. 1916 | 2 | ... | ... | ... | 100 | ... | ... | ... | ... | 2 coats |
| " | Dip | " | " " " | 4 | " " | 5 | 40.0 | ... | ... | 60.0 | ... | ... | ... | ... | 2 minute dip |
| " | Brush | C. T. C. | " " " | 4 | " " | 2 | ... | ... | ... | 100 | ... | ... | ... | ... | 2 coats |
| " | Dip | " | " " " | 4 | " " | 5 | 20.0 | ... | ... | 80.0 | ... | ... | ... | ... | 2 minute dip |
| " | Open tank | " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | ... | Hot bath 2 hours |
| " | " " | " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | ... | Hot bath 1/2 hour and cold bath 3/4 hours. |
| " | " " | " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | ... | Entire post treated - 1/2 hr. hot bath; 3/4 hr. cold |
| " | Untreated | ... | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | ... | 1 |
| Ash, green | Open tank | C. T. C. | Ames, Iowa | 6 | June, 1915 | 11 | 64.0 | ... | ... | 27.0 | ... | 9.0 | ... | ... | Butt treatment too short |
| " " | " " | " | " " | 6 | " " | 29 | 55.0 | ... | ... | 28.0 | ... | 17.0 | ... | ... | " " " " |
| " " | " " | " | Oskaloosa, Iowa | 5-1/2 | Nov. 1914 | 34 | 97.1 | ... | ... | 2.9 | ... | ... | ... | ... | Hot and cold bath. Tops are checked [5] |
| Aspen | Untreated | ... | Flagstaff, Arizona | 2 | Nov. 1913 | 10 | 100 | ... | ... | ... | ... | ... | ... | ... | Not green |
| " | " | ... | " " " | 2 | Jan. 1913 | 10 | 100 | ... | ... | ... | ... | ... | ... | ... | Seasoned posts |
| Balsam | Brush | Carbolineum | University Farm, Minn. | 4 | Nov. 1916 | 1 | 100 | ... | ... | ... | ... | ... | ... | ... | 2 coats |
| " | Dip | " | " " " | 4 | Nov. 1916 | 1 | 100 | ... | ... | ... | ... | ... | ... | ... | 2 minute dip |
| " | Dip | C. T. C. | " " " | 4 | " " | 4 | 80.0 | ... | ... | 20.0 | ... | ... | ... | ... | 2 minute dip |
| " | Open tank | " | " " " | 4 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | ... | Hot bath 1/2 hr., cold 3/4 hr. |
| " | " " | " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | ... | Started in hot C.T.C.- left to cool over night. |
| Basswood | " " | " | Ames, Iowa | 6 | June 1915 | 13 | 40.0 | ... | 17.0 | ... | 25.0 | ... | ... | ... | Butt treatment too short |
| " | " " | " | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 310 | 66.8 | 7.9 | 3.2 | 1.6 | 1.6 | 0.6 | ... | ... | Entire post treated - split posts |
| " | " " | " | " " " | 7-1/2 | " " | 22 | 27.3 | 27.3 | ... | 40.9 | ... | 4.5 | ... | ... | " " " " |
| " | " " | " | " " " | 7-1/2 | " " | 25 | 4.0 | 4.0 | ... | 4.0 | 80.0 | 16.0 | ... | ... | Entire post treated - cold oil only - split posts |
| " | " " | W.G.T.&C. | " " " | 7-1/2 | " " | 34 | 26.1 | 8.8 | 4.4 | ... | 8.8 | ... | ... | ... | Entire post treated |
| " | " " | C. T. C. | " " " | 7-1/2 | " " | 18 | 20.0 | 20.0 | ... | 46.7 | 6.7 | 13.3 | ... | ... | " " " " |
| Bay, Sweet | Open tank | C. T. C. | Calhoun, Louisiana | 5 + | Jan. 1916 | 146 | 78.4 | ... | ... | 8.8 | ... | 12.9 | ... | ... | Entire post treated |
| Beech | " " | " | College Park, Md. | 6 | Nov. 1914 | 25 | 92.0 | ... | ... | 8.0 | ... | ... | ... | ... | Entire post treated - double tank |
| Beech | " " | " | " " " | 6 | " " | 5 | 80.0 | ... | ... | 20.0 | ... | ... | ... | ... | Single tank |
| " | " " | " | " " " | 6 | " " | 10 | 100 | ... | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - Cold bath C. T. C. |
| " | " " | W. G.T. & C. | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | ... | " " " " |
| " | Untreated | ... | " " " | 6 | " " | 5 | 60.0 | ... | ... | 40.0 | ... | ... | ... | ... | " " " " |
| Birch | Dip | Carbolineum | University Farm, Minn. | 4 | Nov. 1916 | 1 | 100 | ... | ... | ... | ... | ... | ... | ... | 2 minute dip |
| " | " | C. T. C. | " " " | 4 | " " | 2 | 100 | ... | ... | ... | ... | ... | ... | ... | 2 " " |
| " | Open tank | " | " " " | 4 | " " | 1 | 100 | ... | ... | ... | ... | ... | ... | ... | Hot C. T. C. 2 hours |
| " | Untreated | ... | " " " | 4 | " " | 2 | ... | ... | ... | 100 | ... | ... | ... | ... | 1 |
| Birch, River | Open tank | C. T. C. | College Park, Md. | 6 | Nov. 1914 | 30 | 86.7 | ... | ... | 3.3 | ... | ... | ... | ... | Entire post treated - double tank |
| " " | " " | " | " " " | 6 | " " | 10 | 70.0 | ... | ... | 10.0 | ... | 20.0 | ... | ... | Hot bath crude petroleum. Cold bath C.T.C. |
| " " | " " | " | " " " | " | " " | " | " | " | " | " | " | " | " | " | Irregular penetration |
| " " | Soaking | W. G. T. | " " " | 6 | " " | 5 | 40.0 | ... | ... | 20.0 | ... | 40.0 | ... | ... | No cold bath |
| " " | Untreated | ... | " " " | 6 | " " | 5 | 40.0 | ... | ... | ... | ... | 60.0 | ... | ... | 1 |
| Birch, Yellow | Open tank | C. T. C. | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 3 | ... | 33.3 | ... | ... | 66.7 | ... | ... | ... | 1 |
| " " | " " | " | " " " | 7-1/2 | " " | 6 | 83.3 | ... | ... | ... | 16.7 | ... | ... | ... | Entire post treated |
| Boxelder | " " | " | Oskaloosa, Iowa | 5-1/2 | Nov. 1914 | 10 | 40.0 | 40.0 | ... | ... | 20.0 | ... | ... | ... | Two posts show no sign of treatment [5] |
| Butternut | " " | " | Ames, Iowa | 6 | June 1915 | 18 | 33.0 | 50.0 | ... | ... | 17.0 | ... | ... | ... | 1 |
| " | " " | " | " " " | 6-1/2 | " " | 25 | 64.0 | ... | ... | 28.0 | ... | 8.0 | ... | ... | 1 |
| Cedar, Northern White | Brush | Carbolineum | University Farm, Minn. | 4 | Nov. 1916 | 5 | 20.0 | ... | ... | 80.0 | ... | ... | ... | ... | 2 coats |
| " " " | Dip | " | " " " | 4 | " " | 10 | 20.0 | ... | ... | 80.0 | ... | ... | ... | ... | 1 minute dip |
| " " " | " | " | " " " | 4 | " " | 4 | 72.0 | ... | ... | 28.0 | ... | ... | ... | ... | 5 minute dip |
| " " " | Brush | C. T. C. | " " " | 4 | " " | 3 | ... | ... | ... | 100 | ... | ... | ... | ... | 2 coats |
| " " " | Dip | " | " " " | 4 | " " | 7 | 100 | ... | ... | ... | ... | ... | ... | ... | 1 minute dip |
| " " " | " | " | " " " | 4 | " " | 11 | 63.6 | ... | ... | 36.4 | ... | ... | ... | ... | 5 minute dip |
| " " " | " | " | " " " | 4 | " " | 9 | 66.7 | ... | ... | 33.3 | ... | ... | ... | ... | 10 minute dip |
| " " " | Open tank | " | " " " | 4 | " " | 19 | ... | ... | ... | ... | ... | ... | ... | ... | Hot C. T. C. two hours |
| " " " | " " | " | " " " | 4 | " " | 10 | 100 | ... | ... | ... | ... | ... | ... | ... | 1/2 hr. hot C. T. C., 1/2 hr. cold |
| " " " | " " | " | " " " | 4 | " " | 2 | 100 | ... | ... | ... | ... | ... | ... | ... | 3/4 " " " 3/4 " " |
| " " " | " " | " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | ... | 3/4 " " " 1/2 " " |
| Cedar, Idaho | " " | " | Nat'l. Bison Range, Mont. | 7 | Sept. 1916 | 7044 | 100 | ... | ... | ... | ... | ... | ... | ... | Fire killed cedar. Single tank treated. Absorption 1/4 to 1/5 gal. |
| Cedar, Incense | Untreated | ... | Col. National Forest | 8 | Aug. 1916 | 63 | 100 | ... | ... | ... | ... | ... | ... | ... | Seasoned split posts |
| " | " | ... | Plumas National Forest, California | 1 | June 1914 | 12 | 100 | ... | ... | ... | ... | ... | ... | ... | Split posts, seasoned one month |
| Cedar, Red (Juniper) | Open tank | C. T. C. | College Park, Md. | 6 | Nov. 1914 | 88 | 100 | ... | ... | ... | ... | ... | ... | ... | Entire post treated - double tank |
| " " " | " " | " | " " " | 6 | " " | 6 | 100 | ... | ... | ... | ... | ... | ... | ... | Single tank |
| " " " | " " | " | " " " | 6 | " " | 6 | 100 | ... | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - Cold bath C. T. C. |
| " " " | Untreated | ... | " " " | 6 | " " | 2 | 100 | ... | ... | ... | ... | ... | ... | ... | 1 |
| Cedar, Northern White | Open tank | C. T. C. | Ames, Iowa | 8 | June 1915 | 824 | 99.4 | ... | ... | ... | ... | ... | 0.4 | ... | Removed for other cause than decay |
| " " " | " " | " | " " | 8 | " " | 830 | 98.9 | 0.9 | 0.9 | ... | ... | ... | 0.9 | ... | " " " " " " |
| " " " | " " | " | " " | 3 | " " | 16 | 100 | ... | ... | ... | ... | ... | ... | ... | 1 |
| " " " | Untreated | ... | " " | 3 | " " | 6 | 100 | ... | ... | ... | ... | ... | ... | ... | 1 |

Note.— * Unless otherwise specified only the butts of posts were treated.
C. T. C. - Coal tar creosote - Unless otherwise stated in "Remarks" a hot and cold bath was employed.
W. G. T. & C. - Water gas tar & creosote - Unless otherwise stated in "Remarks" a hot bath of water gas tar and a cold bath of coal tar creosote were employed.
W. G. T. - Water gas tar - Unless otherwise stated in "Remarks" a hot and cold bath was employed.
R. L. A. - Neut-liquid asphaltum
1 Includes 6 posts, both butts and tops partly decayed.
2 " 1 post , both butt and top decayed.
3 " 1 " " " " partly decayed.
4 " 1 " " " " decayed.
5 Inspected by Mr. G. B. MacDonald, Professor of Forestry, Iowa State College.

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## SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

| Species | Preparation | Preservative Sold as | Treatment | Location: Line* | Location: State | Date Set | Date Inspected | No. Set | Removed: causes other than decay | Not Inspected | Total No. in Summary | % Sound | % Partially Decayed | % Removed for Decay | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cedar, Incense | ... | ... | Untreated | S. P. P. | California | 1911 | 1914 | 150 | 1 | ... | 149 | 36.9 | 60.4 | 2.7 | Heartwood sawed 4" x 4" x 20'. |
| " W. White | Seasoned | Carbolineum, Avenarius | Brush | O.-D. | Nebraska | 1910 | 1914 | 93 | 2 | ... | 91 | 47.2 | 51.6 | 1.1 | |
| " " " | " | Creosote, Coal Tar | " | O.-D. | Nebraska | 1910 | 1916 | 98 | ... | ... | 98 | 7.4 | 90.8 | 2.1 | |
| " " " | Green | " " " | Open tank | O.-D. | Nebraska | 1910 | 1916 | 45 | ... | ... | 45 | 97.7 | 2.3 | ... | |
| " " " | Seasoned | " " " | " | O.-D. | Nebraska | 1910 | 1916 | 137 | 8 | ... | 132 | 100 | ... | ... | |
| " " " | " | ... | " | O.-D. | Nebraska | 1910 | 1916 | 98 | 2 | ... | 96 | ... | 94.8 | 5.2 | |
| Cedar, S. White | " | Carbolineum, Avenarius | Brush- 2 coats | S.-M. | Georgia | 1905 | 1915 | 24 | ... | ... | 24 | ... | 54.2 | 45.8 | |
| " " " | " | Carbolineum, S. P. P. | " 1 coat | S.-M. | Georgia | 1905 | 1915 | 3 | ... | ... | 3 | ... | ... | 100 | |
| " " " | " | " | " 2 coats | S.-M. | Georgia | 1905 | 1915 | 21 | 1 | ... | 20 | ... | 40.0 | 60.0 | |
| " " " | " | Creolin | " 2 coats | S.-M. | " | 1905 | 1915 | 24 | 1 | ... | 23 | ... | 43.5 | 56.5 | |
| " " " | " | Creosote, Coal Tar | " 2 coats | S.-M. | " | 1905 | 1915 | 34 | 2 | ... | 32 | ... | 43.7 | 56.3 | |
| " " " | " | " " " | " | S.-M. | " | 1905 | 1915 | 14 | 4 | ... | 10 | ... | 40.0 | 60.0 | |
| " " " | " | Imperial Wood Preserver | " | S.-M. | " | 1905 | 1915 | 24 | 4 | ... | 20 | ... | 54.0 | 46.0 | |
| " " " | " | Spiritine | " | S.-M. | " | 1905 | 1915 | 24 | 1 | ... | 23 | ... | 26.1 | 73.9 | |
| " " " | Green | Tar, Coal | " | S.-M. | " | 1905 | 1915 | 12 | 1 | ... | 11 | ... | 9.1 | 90.8 | |
| " " " | Seasoned | " " | " | S.-M. | " | 1905 | 1915 | 24 | 1 | ... | 23 | ... | 26.1 | 73.9 | |
| " " " | Green | ... | Untreated | S.-M. | " | 1905 | 1915 | 96 | 5 | ... | 91 | ... | 11.0 | 89.0 | |
| " " " | Seasoned | ... | " | S.-M. | " | 1905 | 1915 | 108 | 8 | ... | 100 | ... | 6.0 | 94.0 | |
| Cedar, W. Red | " | Carbolineum | Brush | Various | California | 1907-09 | 1916 | 82 | ... | ... | 82 | 25.1 | 73.0 | 1.9 | Set in vicinity of Los Angeles, Cal. |
| " " " | " | Creosote, Coal Tar | " | " | " | 1907-09 | 1916 | 53 | ... | ... | 53 | 50.2 | 49.8 | ... | " " " " " " " |
| " " " | " | " " " | Open tank | " | " | 1907-09 | 1916 | 413 | ... | ... | 413 | 96.9 | 3.1 | ... | " " " " " " " |
| " " " | " | Crude Oil | " | " | " | 1907-09 | 1916 | 4 | ... | ... | 4 | 50.0 | 50.0 | ... | " " " " " " " |
| " " " | " | Zinc Chloride | " | " | " | 1907-09 | 1916 | 151 | ... | ... | 151 | 15.9 | 84.1 | 2.0 | " " " " " " " |
| " " " | " | Zinc Chloride & Creosote | " | " | " | 1907-09 | 1916 | 49 | ... | ... | 49 | 46.9 | 53.1 | ... | " " " " " " " |
| " " " | " | ... | Untreated | " | " | 1907-09 | 1916 | 57 | ... | ... | 57 | ... | 73.7 | 26.3 | " " " " " " " |
| Chestnut | Seasoned | Carbolineum, Avenarius | Brush | O.-D. | Nebraska | 1910 | 1916 | 98 | ... | ... | 98 | 23.9 | 75.9 | 2.2 | |
| " | ... | " " " | " | P.-M. S. | New Jersey | 1902 | 1913 | 10 | ... | ... | 10 | ... | 100 | ... | Treated green. |
| " | Seasoned | " " " | Brush - 1 coat | V.-B. | Pa. & N.Y. | 1905 | 1916 | 8 | ... | ... | 8 | ... | 100 | ... | |
| " | " | " " " | " | S.-M. | Georgia | 1905 | 1916 | 4 | ... | ... | 4 | ... | 100 | ... | |
| " | " | " " " | 2 coats | V.-B. | Pa. & N.Y. | 1905 | 1916 | 66 | ... | ... | 66 | 54.6 | 45.4 | ... | |
| " | " | " " " | 2 coats | S.-M. | Georgia | 1905 | 1916 | 18 | ... | 1 | 17 | 17.6 | 70.6 | 11.8 | |
| " | " | Carbolineum, S. P. P. | 1 coat | V.-B. | New York | 1905 | 1916 | 10 | ... | ... | 10 | 10.0 | 90.0 | ... | |
| " | " | " " " | 1 " | S.-M. | Georgia | 1905 | 1916 | 2 | ... | ... | 2 | ... | 50.0 | 50.0 | |
| " | " | " " " | 2 coats | V.-B. | Pa. & N.Y. | 1905 | 1916 | 66 | ... | ... | 66 | 41.4 | 57.6 | ... | |
| " | " | " " " | 2 " | S.-M. | Georgia | 1905 | 1916 | 18 | 1 | 2 | 15 | 20.0 | 66.6 | 26.7 | |
| " | " | Creolin | 1 coat | V.-B. | Pa. & N.Y. | 1905 | 1916 | 16 | ... | ... | 16 | ... | 100 | ... | |
| " | " | " " | 2 coats | V.-B. | Pa. & N.Y. | 1905 | 1916 | 62 | ... | ... | 62 | ... | 100 | ... | One pole marked for renewal. |
| " | " | " " | 2 " | S.-M. | Georgia | 1905 | 1916 | 24 | ... | 2 | 22 | 4.5 | 54.6 | 40.9 | |
| " | Seasoned | Creosote, Coal Tar | Brush | O.-D. | Nebraska | 1910 | 1916 | 98 | ... | ... | 98 | 2.0 | 94.6 | 3.4 | |
| " | Seasoned | " " " | " 1 coat | S.-M. | Georgia | 1905 | 1916 | 2 | ... | ... | 2 | ... | 100 | ... | |
| " | " | " " " | " 2 coats | S.-M. | Georgia | 1905 | 1916 | 41 | 4 | 6 | 33 | 12.1 | 60.6 | 27.3 | |
| " | " | " " " | " 2 " | S.-M. | Pa. & N.Y. | 1905 | 1916 | 64 | ... | ... | 64 | 60.7 | 39.3 | ... | |
| " | " | " " " | " 3 " | S.-M. | Georgia | 1905 | 1916 | 6 | ... | ... | 6 | ... | 60.0 | 40.0 | |
| " | Green | " " " | Open tank | W.-B. | Pa. & N.Y. | 1905 | 1916 | 28 | ... | ... | 28 | 92.9 | 7.1 | ... | |
| " | Seasoned | " " " | " | V.-B. | Pa. & N.Y. | 1905 | 1916 | 183 | ... | ... | 183 | 98.0 | 2.0 | ... | |
| " | " | " " " | " | O.-D. | Nebraska | 1910 | 1916 | 190 | ... | ... | 190 | 93.6 | 5.8 | 0.6 | |
| " | " | Creosote, Wood | Brush 1 coat | W.-B. | Pa. & N.Y. | 1908 | 1916 | 21 | ... | ... | 21 | ... | 100 | ... | |
| " | " | " " | " 2 coats | W.-B. | Pa. & N.Y. | 1906 | 1916 | 49 | ... | ... | 49 | 28.6 | 71.4 | ... | |
| " | " | Imperial Wood Preserver | " 2 " | S.-M. | Georgia | 1905 | 1916 | 24 | 1 | ... | 23 | ... | 43.5 | 56.5 | |
| " | ... | Spiritine | " | P.-M. S. | New Jersey | 1902 | 1913 | 11 | ... | ... | 11 | ... | 100 | ... | Treated green. |
| " | Seasoned | " | " 3 coats | S.-M. | Georgia | 1905 | 1916 | 24 | 1 | 2 | 21 | 4.8 | 38.1 | 57.1 | |
| " | " | Tar | " 1 coat | V.-B. | Pa. & N.Y. | 1905 | 1916 | 48 | ... | ... | 48 | ... | 100 | ... | |
| " | Green | Tar, Coal | " | S.-M. | Georgia | 1905 | 1916 | 8 | ... | 1 | 7 | ... | 28.6 | 71.4 | |
| " | Seasoned | " | " | S.-M. | Georgia | 1905 | 1916 | 21 | ... | 1 | 20 | ... | 55.0 | 45.0 | |
| " | Green | Tar, Pine | " | S.-M. | Georgia | 1905 | 1916 | 4 | ... | 1 | 3 | ... | 33.3 | 66.7 | |
| " | Seasoned | " | " | S.-M. | Georgia | 1905 | 1913 | 3 | ... | ... | 3 | ... | 100 | ... | |
| " | ... | ... | Charred | P.-M. S. | New Jersey | 1902 | 1913 | 6 | ... | ... | 6 | ... | 100 | ... | |
| Chestnut | Green | ... | Untreated | V.-B. | Pa. & N.Y. | 1905 | 1916 | 198 | ... | ... | 198 | ... | 100 | ... | |
| " | " | ... | " | S.-M. | Georgia | 1905 | 1916 | 96 | 1 | 9 | 86 | ... | 63.9 | 36.1 | |
| " | Seasoned | ... | " | V.-B. | Pa. & N.Y. | 1905 | 1916 | 364 | ... | ... | 364 | ... | 100 | ... | One pole marked for removal. |
| " | " | ... | " | O.-D. | Nebraska | 1910 | 1916 | 179 | 4 | ... | 175 | ... | 94.3 | 5.7 | |
| " | " | ... | " | S.-M. | Georgia | 1905 | 1916 | 115 | 2 | 9 | 101 | ... | 39.6 | 60.4 | |
| " | " | ... | " | P.-M. S. | New Jersey | 1902 | 1913 | 21 | 1 | 1 | 9 | ... | 100 | ... | Set in sand. |
| " | " | ... | " | " | " | 1902 | 1913 | 21 | 2 | ... | 19 | ... | 89.6 | 5.4 | Set in sandy loam. |
| " | " | ... | " | " | " | 1902 | 1913 | 8 | ... | ... | 8 | ... | 100 | ... | Set in crushed stone. |
| Cypress | " | ... | " | S.-J. | Florida | 1908 | 1913 | 58 | 2 | 1 | 55 | 3.4 | 48.3 | 48.3 | |
| Fir, Douglas | Seasoned | Creosote, Coal Tar | Open tank | C. H. P. | California | 1918 | 1918 | 119 | ... | ... | 119 | 100 | ... | ... | |
| " | " | " " " | Charred | " | " | 1910 | 1912 | 2 | ... | ... | 2 | 100 | ... | ... | |
| " | " | " " " | Untreated | " | " | 1918 | 1918 | 14 | 2 | ... | 14 | 76.6 | 23.4 | ... | Removals on account of insect attack. |
| Palmetto | ... | ... | ... | S.-J. | Florida | 1908 | 1913 | 79 | ... | ... | 79 | ... | ... | 100 | 45 poles roofed with galvanized iron. Ave. life 8-9 yrs. |
| Pine, Ledgepole | ... | Creosote, Coal Tar | Open tank | A. M. Co. | Montana | 1918 | 1916 | 111 | ... | ... | 111 | 100 | ... | ... | |
| Pine, N. yellow | Seasoned | Carbolineum | Brush | Various | California | 1907-08 | 1918 | 111 | ... | ... | 111 | 18.2 | ... | 81.8 | Set in vicinity of Los Angeles, Cal. |
| " " " | " | Carbolineum, Avenarius | " | " | " | 1908 | 1914 | 44 | ... | ... | 44 | 4.6 | 9.1 | 86.3 | " " " " Fresno, Cal. |
| " " " | " | " " " | " | " | " | 1911 | 1914 | 1 | ... | ... | 1 | 100 | ... | ... | " " " " " " |
| " " " | " | Carbolineum | " | " | " | 1907 | 1912 | 71 | ... | ... | 71 | 14.5 | ... | 85.5 | " " " " " " |
| " " " | " | Creosote, Coal Tar | " | " | " | 1908 | 1914 | 47 | ... | ... | 47 | 7.1 | 10.4 | 82.5 | " " " " " " |
| " " " | " | " " " | " | " | " | 1907 | 1918 | 21 | ... | ... | 21 | 14.3 | 9.5 | 76.2 | " " " " " " |
| " " " | " | " " " | Open tank | " | " | 1907-08 | 1913 | 28 | ... | ... | 28 | 100 | ... | ... | Set in vicinity of Los Angeles, Cal. |
| " " " | " | " " " | " | " | " | 1908 | 1914 | 236 | ... | ... | 236 | 94.9 | 1.3 | 3.8 | " " " " Fresno, Cal. |
| " " " | " | " " " | " | " | " | 1911 | 1914 | 28 | ... | ... | 28 | 96.4 | 3.6 | ... | " " " " " " |
| " " " | " | " " " | " | " | " | 1911 | 1914 | 1 | ... | ... | 1 | 100 | ... | ... | " " " " " " |
| " " " | " | Pitmag | " | " | " | 1911 | 1914 | 21 | ... | ... | 21 | 100 | ... | ... | " " " " " " |
| " " " | " | Creosote & Crude Oil | Open tank | " | " | 1911 | 1914 | 4 | ... | ... | 4 | 75.0 | 25.0 | ... | " " " " " " |
| " " " | " | Crude Oil | " | " | " | 1908 | 1914 | 153 | ... | ... | 153 | 69.2 | 7.7 | 23.1 | " " " " " " |
| " " " | " | " " | " | " | " | 1911 | 1914 | 8 | ... | ... | 8 | 75.0 | ... | 25.0 | " " " " " " |
| " " " | " | Zinc Chloride | " | " | " | 1908 | 1914 | 45 | ... | ... | 42 | 80.0 | 11.9 | 38.1 | " " " " " " |
| " " " | " | " " | " | " | " | 1911 | 1914 | 16 | ... | ... | 13 | 77.8 | 16.7 | 5.5 | " " " " " " |
| " " " | " | ... | Untreated | " | " | 1907-08 | 1913 | 14 | ... | ... | 14 | ... | 7.1 | 92.7 | " " " " Los Angeles, Cal. |
| " " " | " | ... | " | " | " | 1908 | 1914 | 13 | ... | ... | 13 | ... | ... | 100 | " " " " Fresno, Cal. Ave. life 3.2 years. |

*Contains water gas tar oils.

* A. M. Co. - Anaconda Mining Company.
S. P. P. - Southern Pine Preserving Company.

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## SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

| Species | Method of Treatment | Location | Years of Service at Last Inspection | Date of Last Inspection | Total No. of Posts | % Sound | % Partly Decayed: Tops | % Partly Decayed: Butts | % Decayed: Tops | % Decayed: Butts | % Removed for Decay | % Not Inspected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chestnut | Open tank: C. T. C. | College Park, Md. | 6 | Nov. 1914 | 32 | 93.8 | ... | 6.2 | ... | ... | ... | ... | Entire post treated - double tank |
| " | " " " | " " " | 6 | " " | 8 | 100 | ... | ... | ... | ... | ... | ... | Single tank |
| " | Untreated: .... | " " " | 6 | " " | 8 | 50.0 | ... | ... | ... | 50.0 | ... | ... | |
| Cottonwood | Open tank: C. T. C. | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 43 | 93.1 | 2.3 | ... | 2.3 | 2.3 | ... | ... | 4 of the sound posts are split - Entire post tr'd. |
| " | " " " | " " " | 7-1/2 | " " | 3 | 66.7 | ... | ... | 33.3 | ... | ... | ... | |
| " | " " " | Danville, Iowa | 9-1/2 | Nov. 1914 | 9 | 88.9 | 11.1 | ... | ... | ... | ... | ... | Inspected by Mr. G.J. MacDonald. Tops are checked. |
| " | " " " | Fort Atkinson, Iowa | 8-1/2-9-1/2 | " " | 19 | 47.3 | 26.3 | 21.6 | 105.6 | 5.3 | ... | ... | " " " 2 posts have both butt and top partly decayed.1 post both butt and top decayed. |
| Cypress | " " " | Calhoun, Louisiana | 5 - 7 | Jan. 1915 | 71 | 96.0 | ... | ... | ... | ... | 2.0 | 2.0 | Entire post treated. |
| Elm, Red | " " " | Ames, Iowa | 5-1/2 | June 1916 | 15 | 67.0 | 6.6 | 13.2 | ... | 13.2 | ... | ... | |
| " " | " " " | " " " | 7 | " " | 7 | 71.4 | 14.3 | ... | ... | ... | ... | 14.3 | Removed for cause other than decay. |
| " " | " " " | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 18 | 83.3 | ... | ... | ... | 16.7 | ... | ... | Entire post treated. 4 posts treated with cold oil only. Split posts. |
| " " | " " " | " " " | 7-1/2 | " " | 2 | 100 | ... | ... | ... | ... | ... | ... | Split posts. |
| Eucalyptus Globulus | Dip " | Santa Barbara, Cal. | 4 | July 1909 | 6 | ... | ... | ... | ... | 100 | ... | ... | |
| " " | Open tank: | " " " | 4 | " " | 50 | 86.8 | 11.7 | 1.5 | ... | ... | ... | ... | |
| " " | " " " | San Mateo Lead Co.,Cal. | 8 | Nov. 1913 | 25 | 48.8 | ... | 12.4 | ... | 38.8 | ... | ... | Green unpeeled posts - Hot bath only. |
| " " | " " " | " " " | 8 | " " | 25 | 48.8 | ... | 12.4 | ... | 38.8 | ... | ... | Green peeled posts - Hot bath only. |
| " " | " " " | " " " | 8 | " " | 16 | 87.5 | ... | 6.2 | ... | 6.3 | ... | ... | Seasoned unpeeled posts - Hot bath only. |
| " " | " " " | " " " | 8 | " " | 6 | 33.3 | ... | 66.7 | ... | ... | ... | ... | Green unpeeled posts. |
| " " | " " " | " " " | 8 | " " | 3 | 66.7 | ... | ... | ... | 33.3 | ... | ... | Seasoned unpeeled posts. |
| Eucalyptus Rostrata | " " " | Santa Barbara, Cal. | 4 | July 1909 | 104 | 93.3 | 1.0 | 1.9 | ... | 3.8 | ... | ... | |
| Eucalyptus Sideroxylon | " " " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | |
| Fir, Alpine | " " " | Routt County, Colorado | 4 | Nov. 1916 | 6 | 66.7 | ... | ... | ... | ... | ... | 33.3 | |
| " " | " " " | " " " | 1 | Sept. 1911 | 2 | 100 | ... | ... | ... | ... | ... | ... | Hot bath - cooling over night - fire killed - seasoned 27 years. |
| " " | " " " | " " " | 4 | Nov. 1912 | 29 | 86.2 | ... | 13.8 | ... | ... | ... | ... | Hot bath - fire killed - seasoned 27 years. |
| " " | " " " | " " " | 1 | Sept. 1911 | 7 | 85.7 | ... | ... | ... | ... | ... | 14.3 | " " " " " " " |
| " " | " " " | " " " | 4 | Nov. 1916 | 5 | 100 | ... | ... | ... | ... | ... | ... | Hot bath - short cooling - fire killed - seasoned 27 years. |
| " " | " " " | " " " | 1 | Sept. 1911 | 2 | 100 | ... | ... | ... | ... | ... | ... | " " " " " " " |
| " " | " " " | " " " | 4 | Nov. 1912 | 1 | 100 | ... | ... | ... | ... | ... | ... | Cut green - seasoned - hot bath. |
| " " | " " " | " " " | 1 | Sept. 1911 | 1 | 100 | ... | ... | ... | ... | ... | ... | " " " " " " |
| " " | Brush W. C. T. | Fort Collins, Colorado | 4 | 1916 | 10 | 90.0 | ... | 10.0 | ... | ... | ... | ... | 2 coats - fire killed in 1898. |
| " " | Open tank: | " " " | 4 | 1916 | 10 | 90.0 | ... | ... | ... | ... | ... | 10.0 | Hot bath 2 hrs. - fire killed in 1898. |
| " " | Untreated: .... | Routt County, Colorado | 5 | Nov. 1916 | 5 | 20.0 | ... | ... | ... | 60.0 | ... | 20.0 | Fire killed. |
| " " | " " .... | Fort Collins, Colorado | 4 | 1916 | 10 | 80.0 | ... | 70.0 | ... | 10.0 | ... | ... | Fire killed in 1898. |
| Fir, Douglas | " " .... | Flagstaff, Arizona | 2 | Nov. 1912 | 12 | 100 | ... | ... | ... | ... | ... | ... | Cut from sand tree. |
| Gum, Black | Brush C. T. C. | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 8 | 12.5 | ... | ... | ... | 50.0 | 25.0 | 12.5 | Butts 3 coats - tops 2 coats |
| " " | Charred " " | " " " | 5-1/2 - 6 | " " | 8 | ... | ... | ... | ... | ... | 100. | ... | |
| " " | Open tank: C. T. C. | Calhoun, Louisiana | 5 - 7 | " " | 60 | 100 | ... | ... | ... | ... | ... | ... | Entire post treated. |
| " " | " " " | College Park, Md. | 6 | Nov. 1914 | 86 | 94.8 | ... | 5.2 | ... | ... | ... | ... | " " " |
| " " | " " " | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | Single tank. |
| " " | " " " | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 5 | 33.0 | ... | ... | ... | 67.0 | ... | ... | Tops soaked in cold oil for short time. |
| " " | Brush W. C. T. | College Park, Md. | 6 | Nov. 1914 | 9 | 66.7 | ... | ... | ... | 33.3 | ... | ... | No cold bath. |
| " " | Untreated: .... | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 2 | ... | ... | ... | ... | 100 | ... | ... | |
| " " | " " .... | College Park, Md. | 6 | Nov. 1914 | 5 | 60.0 | ... | 20.0 | ... | 20.0 | ... | ... | |
| Gum, Sweet | Open tank: C. T. C. | Auburn, Alabama | 6-1/2 | Jan. 1914 | 87 | 84.0 | ... | 2.5 | ... | ... | 11.0 | 2.5 | Piled on ground 1-1/2 years before setting. A number were treated while green. |
| " " | " " " | Calhoun, Louisiana | 5 - 7 | Jan. 1915 | 177 | 96.1 | 1.7 | 1.1 | ... | 1.1 | ... | ... | Entire post treated. |
| " " | " " " | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 7 | 28.6 | ... | ... | ... | 14.2 | 57.2 | ... | |
| " " | " " " | College Park, Md. | 6 | Nov. 1914 | 79 | 82.8 | 3.4 | 7.0 | ... | 3.4 | ... | 3.4 | Entire post treated. |
| " " | " " " | " " " | 6 | " " | 8 | 100 | ... | ... | ... | ... | ... | ... | Single tank. |
| " " | " " " | " " " | 6 | " " | 11 | 72.7 | ... | 27.3 | ... | ... | ... | ... | Hot bath crude petroleum - 3 posts received no cold bath or creosote. |
| " " | Untreated: .... | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 1 | ... | ... | ... | ... | 100 | ... | ... | |
| " " | " " .... | College Park, Md. | 6 | Nov. 1914 | 5 | 60.0 | ... | ... | ... | 40.0 | ... | ... | |
| Gum, Tupelo | Open tank: C. T. C. | Calhoun, Louisiana | 5 - 7 | Jan. 1915 | 61 | 93.4 | ... | 3.3 | ... | 3.3 | 1.2 | ... | Entire post treated. |
| Hackberry | " " " | Ames, Iowa | 5 | June 1913 | 1 | 100 | ... | ... | ... | ... | ... | ... | Butt treatment tops short. |
| Hickory | Brush " | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 3 | 66.7 | ... | ... | ... | ... | 33.3 | ... | Butts 3 coats. Tops 2 coats. |
| " | Charred " " | " " " | 5-1/2 - 6 | " " | 2 | ... | ... | ... | ... | ... | 100 | ... | |
| " | Open tank: C. T. C. | " " " | 5-1/2 - 6 | " " | 5 | 50.0 | ... | 50.0 | ... | ... | ... | 50.0 | Single tank - tops soaked in cold oil. |
| " | Untreated: .... | " " " | 5-1/2 - 6 | " " | 1 | ... | ... | ... | ... | 100 | ... | ... | |
| Juniper, Alligator | " " .... | Flagstaff, Arizona | 2 | Jan. 1913 | 10 | 100 | ... | ... | ... | ... | ... | ... | Seasoned 6 months. |
| " One-seed | " " .... | " " " | 2 | " " | 10 | 100 | ... | ... | ... | ... | ... | ... | " " |
| Locust, Black | Open tank: C. T. C. | College Park, Md. | 6 | Nov. 1914 | 86 | 100 | ... | ... | ... | ... | ... | ... | Entire post treated. |
| " " | " " " | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | Single tank. |

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## SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

| Species | Method of Treatment | Location | Years of Service at Last Inspection | Date of Last Inspection | Total No. of Posts | % Sound | % Partly Decayed Tops | % Partly Decayed Butts | % Decayed Tops | % Decayed Butts | % Removed for Decay | % Not Inspected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Locust, Black | Open tank: C. T. C. | College Park, Md. | 6 | Nov. 1914 | 5 | 100 | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - cold bath C. T. C. |
| " " | Untreated: ... | " " " | 6 | " " | 24 | 96.2 | ... | ... | ... | 3.8 | ... | ... | 20 of these were split posts. |
| Maple, Red | Open tank: C. T. C. | " " " | 6 | " " | 27 | 70.4 | ... | 25.9 | ... | 3.7 | ... | ... | Entire post treated. |
| " " | " " " | " " " | 6 | " " | 13 | 92.3 | ... | ... | ... | ... | ... | 7.7 | Removed when fence was changed. Single tank. |
| " " | " " " | " " " | 6 | " " | 5 | 80.0 | ... | 20.0 | ... | 20.0 | ... | ... | Post received neither cold bath nor creosote. Hot bath crude petroleum. |
| " " | Untreated: ... | " " " | 6 | " " | 5 | 60.0 | ... | ... | ... | ... | ... | 40.0 | |
| Maple, Soft | Open tank: C. T. C. | Oskaloosa, Iowa | 9-1/2 | " " | 25 | 47.8 | 43.5 | ... | 8.7 | ... | ... | ... | Inspected by Mr. C. B. MacDonald. |
| Maple, Sugar | " " " | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 40 | 95.8 | 2.5 | ... | 2.5 | 2.5 | ... | ... | Entire post treated. 3 split posts - 3 posts in cold oil only. |
| " " | " " " | " " " | 7-1/2 | " " | 1 | 100 | ... | ... | ... | ... | ... | ... | |
| Oak, Chestnut | " " " | College Park, Md. | 6 | Nov. 1914 | 15 | 66.7 | ... | 33.3 | ... | ... | ... | ... | Entire post treated. |
| " " | " " " | " " " | 6 | " " | 28 | 100 | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - cold bath C. T. C. |
| " " | W. O. T. | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | Single tank. |
| " " | Untreated: ... | " " " | 6 | " " | 5 | ... | ... | 20.0 | ... | 80.0 | ... | ... | |
| Oak, Cashel | ... | Flagstaff, Arizona | 8 | Jan. 1913 | 10 | 100 | ... | ... | ... | ... | ... | ... | Seasoned 6 months |
| Oak, Pin | Open tank: C. T. C. | College Park, Md. | 6 | Nov. 1914 | 10 | 94.4 | ... | 5.6 | ... | ... | ... | ... | Entire posts treated |
| " " | " " " | " " " | 6 | " " | 7 | 71.4 | ... | 28.6 | ... | ... | ... | ... | Single tank. |
| " " | " " " | " " " | 6 | " " | 10 | 100 | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - cold bath C. T. C. |
| " " | Soaking | " " " | 6 | " " | 15 | 53.3 | ... | 46.7 | ... | 40.0 | ... | ... | No cold bath. |
| Oak, Post | Brush C. T. C. | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1916 | 13 | 53.8 | ... | ... | 7.7 | 23.1 | 15.4 | ... | Butts 3 coats - tops 2 coats. |
| " " | Open tank: " " " | " " " | 5-1/2 - 6 | " " | 59 | 72.9 | 8.1 | 1.7 | 3.4 | 1.7 | 10.2 | ... | Entire post treated. Half double tank - half single |
| " " | " " " | " " " | 5-1/2 - 6 | " " | 11 | 100 | ... | ... | ... | ... | ... | ... | Split posts. Entire post treated - half double tank and half single. |
| " " | Untreated: ... | " " " | 5-1/2 - 6 | " " | 1 | 100 | ... | ... | ... | ... | ... | ... | |
| " " | " " ... | " " " | 5-1/2 - 6 | " " | 2 | 50.0 | ... | ... | ... | 50.0 | ... | ... | Split posts. |
| Oak, Red | Open tank: C. T. C. | Ames, Iowa | 5-1/2 | June 1915 | 5 | ... | 40.0 | 20.0 | ... | 40.0 | ... | ... | Butt treatment too short. |
| " " | " " " | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 10 | 60.0 | 10.0 | ... | ... | 10.0 | 20.0 | ... | Entire post treated. |
| " " | " " " | College Park, Md. | 6 | Nov. 1914 | 20 | 90.0 | ... | 10.0 | ... | ... | ... | ... | " " " |
| " " | " " " | " " " | 6 | " " | 5 | 40.0 | ... | 60.0 | ... | ... | ... | ... | Single tank. |
| " " | W.O.T.& C. | " " " | 6 | " " | 21 | 100 | ... | ... | ... | ... | ... | ... | |
| " " | C. T. C. | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 366 | 99.2 | 0.8 | ... | ... | ... | ... | ... | Entire post treated. |
| " " | " " " | " " " | 7-1/2 | " " | 114 | 89.5 | 8.1 | ... | 2.6 | ... | ... | ... | " " " |
| " " | W.O.T.&C. | " " " | 7-1/2 | " " | 100 | 97.0 | 1.0 | ... | 1.0 | 1.0 | ... | ... | Entire post treated. |
| " " | W. O. T. | " " " | 7-1/2 | " " | 83 | 73.5 | 22.4 | ... | 2.8 | ... | ... | ... | |
| " " | Untreated: ... | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1915 | 1 | ... | ... | ... | ... | 100 | ... | ... | |
| " " | " " ... | College Park, Md. | 6 | Nov. 1914 | 5 | 60.0 | ... | ... | ... | 40.0 | ... | ... | |
| Oak, Valley | " " ... | Cal. National Forest | 2 | July 1915 | 183 | 99.5 | ... | 0.5 | ... | ... | ... | ... | Unseasoned posts. |
| Oak, White | Open tank: C. T. C. | College Park, Md. | 6 | Nov. 1914 | 44 | 88.6 | ... | 11.4 | ... | ... | ... | ... | Entire post treated. |
| Oak, White | " " " | " " " | 6 | Nov. 1914 | 3 | 100 | ... | ... | ... | ... | ... | ... | Single tank. |
| " " | " " " | Dumbra Heights, Minn. | 7-1/2 | July 1916 | 5 | 100 | ... | ... | ... | ... | ... | ... | Entire post treated. |
| " " | Untreated: ... | College Park, Md. | 6 | Nov. 1914 | 4 | 25.0 | ... | 50.0 | ... | 25.0 | ... | ... | |
| Pine, Jack | Brush Carbolineum | University Farm, Minn. | 4 | Nov. 1916 | 7 | 28.6 | ... | 71.4 | ... | ... | ... | ... | 2 coats. |
| " " | Dip " " | " " " | 4 | Nov. 1916 | 10 | 70.0 | ... | 30.0 | ... | ... | ... | ... | 2 minute dip. |
| " " | Brush C. T. C. | " " " | 4 | " " | 4 | 50.0 | ... | 50.0 | ... | ... | ... | ... | 2 coats. |
| " " | Dip " " | " " " | 4 | " " | 10 | 70.0 | ... | 30.0 | ... | ... | ... | ... | 2 minute dip. |
| " " | Open tank: " " | " " " | 4 | " " | 20 | 85.0 | ... | 15.0 | ... | ... | ... | ... | Hot bath 2 hours. |
| " " | " " " | " " " | 4 | " " | 7 | 85.7 | ... | 14.3 | ... | ... | ... | ... | Hot bath 1/2 hour - cold 3/4 hour. |
| " " | " " " | " " " | 4 | " " | 6 | 66.7 | ... | 33.3 | ... | ... | ... | ... | " " " " " " Entire post tr'd. |
| " " | " " " | " " " | 4 | " " | 4 | 100 | ... | ... | ... | ... | ... | ... | Started in hot C.T.C. and left to cool over night. |
| " " | Untreated: ... | " " " | 4 | " " | 18 | 11.1 | ... | 88.9 | ... | ... | ... | ... | |
| Pine, Limber | ... | Flagstaff, Arizona | 2 | Nov. 1912 | 15 | 100 | ... | ... | ... | ... | ... | ... | Cut from dead tree. |
| Pine, Loblolly Pine, Lodgepole | Open tank: C. T. C. Low Pres- sure | Calhoun, Louisiana | 5 - 7 | Jan. 1915 | 395 | 93.4 | 5.0 | 1.8 | ... | 2.1 | ... | ... | Entire post treated. |
| " " | Open tank: " " | Rocker, Montana | 1 | July 1916 | 610 | 100 | ... | ... | ... | ... | ... | ... | Entire post treated. Penetration light & uneven. |
| | | Routt County, Colorado | 6 | Nov. 1916 | 3 | 66.7 | ... | 33.3 | ... | ... | ... | ... | Hot bath - over night cooling - fire killed - Seasoned 27 years. |
| " " | " " " | " " " | 6 | Nov. 1916 | 28 | 71.4 | 3.6 | 21.4 | ... | ... | ... | 3.6 | Hot bath -fire killed - seasoned 27 years. |
| " " | " " " | " " " | 6 | " " | 5 | 20.0 | ... | 40.0 | ... | ... | ... | 40.0 | Hot bath - short cooling - fire killed - seasoned 27 years. |
| " " | Brush Crude oil | Fort Collins, Colorado | 4 | 1916 | 20 | 10.0 | ... | 35.0 | ... | 30.0 | 25.0 | ... | 2 coats hot crude oil, 12 hours apart. Fire killed. |
| " " | " " C. T. C. | " " " | 4 | 1916 | 20 | 80.0 | ... | 20.0 | ... | ... | ... | ... | 2 coats - Fire killed in 1892. |
| " " | Open tank: " " | " " " | 4 | 1916 | 20 | 80.0 | ... | 15.0 | ... | ... | ... | 5.0 | Hot bath 2 hours. Fire killed in 1892. |
| " " | " " " | " " " | 4 | 1916 | 20 | 100 | ... | ... | ... | ... | ... | ... | Hot bath 2 hours-Cold 20 hrs. Fire killed in 1892. |
| " " | " " " | " " " | 4 | 1916 | 20 | 95.0 | ... | ... | ... | ... | ... | 5.0 | Hot bath 1 hr. - Cold 1-2/3hrs. " " " |
| " " | Untreated: ... | " " " | 4 | 1916 | 20 | ... | ... | 60.0 | ... | 25.0 | 25.0 | ... | Fire killed in 1892. |

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## SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

| Species | Method of Treatment | | Location | Years of service at Last Inspection | Date of Last Inspection | Total No. of Posts | % Sound | % Partly Decayed: Top | % Partly Decayed: Butts | % Decayed: Top | % Decayed: Butts | % Removed for Decay | % Not Inspected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Spruce, Engelmann | Open tank | C. T. C. | Routt County, Colorado | 6 | Nov. 1916 | 5 | 80.0 | ... | 20.0 | ... | ... | ... | ... | Hot bath - short cooling - Fire killed - Seasoned 27 years. |
| " " | " " | " | " " " | 1 | Sept. 1911 | 17 | 94.1 | ... | ... | ... | ... | ... | 5.9 | " " " " " " |
| " " | " " | " | " " " | 6 | Nov. 1916 | 17 | 64.7 | ... | 17.6 | ... | ... | ... | 5.9 | Hot bath - fire killed - Seasoned 27 years. |
| " " | " " | " | " " " | 1 | Sept. 1911 | 19 | 89.5 | ... | ... | ... | ... | ... | 10.5 | " " " " " " |
| " " | " " | " | " " " | 6 | Nov. 1916 | 1 | 100 | ... | ... | ... | ... | ... | ... | Cut green - seasoned - hot bath. |
| " " | Brush | V. C. T. | Fort Collins, Colorado | 4 | | 20 | 60.0 | ... | 25.0 | ... | 15.0 | ... | ... | 2 coats - cut green - seasoned 12 months. |
| " " | Open tank | " | " " " | 4 | | 20 | 85.0 | ... | 10.0 | ... | 10.0 | ... | 5.0 | Hot bath 2 hours - cut green - seasoned. |
| " " | " " | " | " " " | 4 | | 20 | 100 | ... | ... | ... | ... | ... | ... | Hot bath 2 hours - cooled 20 hrs. - cut green - seasoned. |
| " " | " " | " | " " " | 4 | 1916 | 20 | 90.0 | ... | 5.0 | ... | ... | ... | 5.0 | Hot bath 2 hrs. - cooled 1-2/3 hrs. - cut green - seasoned. |
| " " | Untreated | ... | Routt County, Colorado | 6 | Nov. 1916 | 5 | ... | ... | 33.3 | ... | 66.7 | ... | ... | Fire killed - seasoned 27 years. |
| " " | " | ... | " " " | 1 | Sept. 1911 | 9 | 88.9 | ... | ... | ... | ... | ... | 11.1 | " " " " " " |
| " " | " | ... | Fort Collins, Colorado | 4 | 1916 | 20 | 85.0 | ... | 5.0 | ... | 10.0 | 10.0 | ... | Cut green - seasoned. |
| Sycamore | Open tank | C. T. C | College Park, Md. | 4 | Nov. 1916 | 25 | 96.0 | ... | 4.0 | ... | ... | ... | ... | Entire post treated. |
| " " | " " | " | " " " | 4 | " " | 5 | 80.0 | ... | 20.0 | ... | ... | ... | ... | Single tank |
| " " | " " | " | " " " | 4 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - cold bath C. T. C. |
| " " | " " | V.S.T.SC. | " " " | 4 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | |
| Willow, Black & White | Untreated | ... | " " " | 4 | " " | 5 | 72.0 | ... | ... | ... | ... | ... | 28.0 | |
| " " " " | Open tank | C. T. C. | " " " | 4 | " " | 60 | 88.7 | ... | 11.3 | ... | ... | ... | ... | Entire post treated. |
| " " " " | " " | " | " " " | 4 | " " | 15 | 93.4 | ... | 6.6 | ... | ... | ... | ... | Single tank. |
| " " " " | " " | " | " " " | 4 | " " | 10 | 60.0 | ... | 20.0 | ... | 20.0 | ... | ... | Hot bath crude petroleum - 2 posts poorly treated. |
| " " " " | " " | " | " " " | 4 | " " | 5 | 80.0 | ... | 20.0 | ... | 20.0 | ... | ... | Hot bath semi-liquid asphaltum. Cold bath C.T.C. |
| " " " " | " " | S. I. A. | " " " | 4 | " " | 5 | 80.0 | ... | 20.0 | ... | 20.0 | ... | ... | Hot bath only. Practically no penetration. |
| " " " " | " " | V.S.T.SC. | " " " | 4 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | |
| " " " " | Untreated | ... | " " " | 4 | " " | 5 | 80.0 | ... | 20.0 | ... | 11.0 | ... | ... | |
| Willow, White | Open tank | C. T. C. | Ames, Iowa | 8-1/2 | June 1915 | 45 | 84.0 | 2.0 | 7.0 | 88.0 | 11.0 | ... | ... | Inspected by Mr. G. B. MacDonald. |
| " " | " " | " | Oskaloosa, Iowa | 9-1/2 | Oct. 1914 | 8 | ... | 88.6 | ... | 46.4 | ... | ... | ... | " " " " " " |
| " " | " " | " | Fort Atkinson, Iowa | 7-1/2-8-1/2 | " " | 8 | 100 | ... | ... | ... | ... | ... | ... | - 6 hr. hot bath |
| " " | " " | " | " " " | " " | " " | 8 | " | " | " | " | " | " | " | Several hours cold. |
| Uncertain | " " | " | Benjamin, Iowa | 7-1/2 | " " | 61 | ... | 44.3 | ... | 55.7 | ... | ... | ... | Inspected by Mr. G. B. MacDonald. |
| " | " " | " | Clemson College, S. C. | 8-1/2 - 9 | Jan. 1915 | 45 | 41.8 | 16.6 | 4.7 | 2.6 | 2.3 | 7.0 | 25.3 | Entire post treated. Made up of 16 holly, 7 yellow pine, 10 yellow poplar, 10 black gum - species of individual posts not determined, however. |

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## SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Concluded.)*

| Species | Method of Treatment | Location | Years of Service at Last Inspection | Date of Last Inspection | Total No. of Posts | % Sound | % Partly Decayed: Tops | % Partly Decayed: Butts | % Decayed: Tops | % Decayed: Butts | % Removed for Decay | % Not Inspected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pine, Longleaf & short-leaf | Open tank: Antinonnin | Cleveland, Texas | 3 | Dec. 1916 | 15 | ... | ... | ... | ... | 100 | ... | ... | Antinonnin 0.12 per cent. Entire post treated. |
| " " " | " " " | " " " | 3 | " " | 13 | 8.3 | ... | ... | ... | 58.4 | ... | ... | " 0.25 " " " " " |
| " " " | " " " | " " " | 3 | " " | 13 | ... | ... | ... | ... | 100 | ... | ... | " 0.50 " " " " " |
| " " " | Painted: Carbolineum C. T. C. | " " " | 3 | " " | 15 | 60.0 | ... | 33.3 | ... | 6.7 | ... | ... | |
| " " " | " " " | " " " | 3 | " " | 6 | 50.0 | ... | 16.7 | ... | 33.3 | ... | ... | Barrett creosote used. " " " |
| " " " | Full cell | " " " | 3 | " " | 15 | ... | ... | ... | ... | 100 | ... | ... | German creosote used. " " " |
| " " " | " " | " " " | 3 | " " | 17 | 100 | ... | ... | ... | ... | ... | ... | " " " " " and are in very good condition. |
| " " " | Purging | " " " | 3 | " " | 22 | 100 | ... | ... | ... | ... | ... | ... | Water wood creosote used. Entire post treated. |
| " " " | Painted: Wood Creosote | " " " | 3 | " " | 13 | ... | ... | ... | ... | 100 | ... | ... | Entire post treated. |
| " " " | " Locustine | " " " | 3 | " " | 15 | ... | ... | ... | ... | 100 | ... | ... | Entire post treated. Painted with 1 coat R.I.W. #139 and one coat R.I.W. #49. |
| " " " | " R.I.W. #139; & R.I.W. #49; | " " " | 3 | " " | 3 | ... | ... | 33.3 | ... | 66.7 | ... | ... | |
| " " " | Open tank: Sodium silico-fluoride | " " " | 3 | " " | 15 | 92.3 | ... | 7.7 | ... | ... | ... | ... | Entire post treated. Sodium silico fluoride 15 " " " " " |
| " " " | " " " | " " " | 3 | " " | 14 | 78.6 | ... | 21.4 | ... | ... | ... | ... | |
| " " " | Untreated | ... | 3 | " " | 15 | ... | ... | ... | ... | 100 | ... | ... | |
| " " " | Open tank: Zinc chloride | " " " | 3 | " " | 10 | 100 | ... | ... | ... | ... | ... | ... | Entire post treated. Zinc chloride 2 per cent. " " " " " 4.5 per cent. |
| " " " | " " " | " " " | 3 | " " | 11 | 100 | ... | ... | ... | ... | ... | ... | |
| Pine, Miscellaneous | Brush: C. T. C. | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1918 | 78 | 82.2 | 1.4 | 0.3 | 1.4 | 13.5 | 60.3 | 4.9 | Butts 5 coats - tops 2 coats. |
| " " | Open tank: | " " " | 5-1/2 - 6 | " " | 26 | 80.8 | ... | 3.8 | ... | ... | ... | 15.4 | Entire post treated. |
| Pine Oldfield | Charred | " " " | 5-1/2 - 6 | " " | 1 | ... | ... | ... | ... | ... | 100 | ... | |
| " " | Open tank: C. T. C. | " " " | 5-1/2 - 6 | " " | 261 | 72.8 | 2.3 | 1.5 | 0.8 | 1.5 | 15.8 | 3.8 | Entire post treated. |
| " " | Untreated | ... | 5-1/2 - 6 | " " | 2 | ... | ... | ... | ... | 50.0 | 50.0 | ... | |
| Pine, Scrub | Open tank: C. T. C. | College Park, Md. | 6 | Nov. 1914 | 56 | 94.6 | ... | 5.4 | ... | ... | ... | ... | Entire post treated. |
| " " | " " " | " " " | 6 | " " | 10 | 100 | ... | ... | ... | ... | ... | ... | Hot bath crude petroleum - cold bath C. T. C. |
| " " | " " " | " " " | 6 | " " | 11 | 100 | ... | ... | ... | ... | ... | ... | Hot bath semi-liquid asphaltum. Cold bath C. T. C. |
| " " | Soaking: S. L. A. | " " " | 6 | " " | 5 | 20.0 | ... | 20.0 | ... | 60.0 | ... | ... | No cold bath. Practically no penetration. |
| " " | Open tank: W. O. T. | " " " | 6 | " " | 14 | 92.9 | ... | 7.1 | ... | ... | ... | ... | No cold bath. |
| " " | Untreated: ... | " " " | 6 | " " | 5 | 40.0 | ... | 40.0 | ... | 20.0 | ... | ... | |
| Pine, western yellow | Untreated: ... | Mt'l. Bison Range, Mont. | 3 | 1918 | 380 | ... | ... | ... | ... | ... | 100 | ... | |
| " " | Untreated: ... | Flagstaff, Arizona | 2 | Jan. 1913 | 51 | 100 | ... | ... | ... | ... | ... | ... | Seasoned posts. |
| " " | " " | " | 2 | Nov. 1917 | 17 | 100 | ... | ... | ... | ... | ... | ... | 6 posts seasoned, 6 green, 5 cut from dead tree. |
| Pine, Yellow | Charred: ... | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1918 | 2 | ... | ... | ... | ... | ... | 100 | ... | |
| " " | Open tank: C. T. C. | Auburn, Alabama | 6-1/2 | " " | 53 | 54.5 | 15.1 | 9.1 | ... | 6.1 | 13.1 | 2.1 | Piled on ground 2-1/2 years - some treated green. |
| " " | " " " | " " " | 6-1/2 | " " | 44 | 84.0 | 2.3 | 2.3 | ... | 2.3 | ... | 9.1 | " " " " " " " |
| " " | " " " | Clemson College, S. C. | 5-1/2 - 6 | " " | 170 | 77.7 | 8.8 | 1.8 | ... | ... | 8.8 | 2.9 | Split posts. |
| " " | Untreated: ... | " " " | 5-1/2 - 6 | " " | 8 | ... | ... | ... | ... | 67.0 | 33.0 | ... | Entire post treated. |
| Pinon | " " | Flagstaff, Arizona | 2 | Jan. 1918 | 10 | 100 | ... | ... | ... | ... | ... | ... | Seasoned 6 months. |
| Poplar | Dip: Carbolineum C. T. C. | University Farm, Minn. | 4 | May. 1916 | 1 | ... | ... | ... | ... | 100 | ... | ... | 2 minute dip |
| " | " " " | " " " | 4 | " " | 2 | ... | ... | ... | ... | 100 | ... | ... | 5 minute dip |
| " | Open tank | " " " | 4 | " " | 1 | 100 | ... | ... | ... | ... | ... | ... | Started hot and left over night to cool. |
| " | " | " " " | 4 | " " | 2 | 100 | ... | ... | ... | ... | ... | ... | Hot bath 1/2 hour. |
| Poplar Silver | " " | College Park, Md. | 6 | 1914 | 20 | 80.0 | ... | 10.0 | ... | ... | ... | ... | Entire post treated. |
| " " | " " | " " " | 6 | " " | 10 | 90.0 | ... | ... | ... | 10.0 | ... | ... | Single tank. |
| " " | " " | " " " | 6 | " " | 5 | 20.0 | ... | 60.0 | ... | 20.0 | ... | ... | Hot bath crude petroleum -irregular penetration. |
| " " | W.W.P.CO. | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | |
| " " | Untreated: ... | " " " | 6 | " " | 5 | 20.0 | ... | 20.0 | ... | 60.0 | ... | ... | |
| Poplar Yellow | Brush: C. T. C. | Clemson College, S. C. | 5-1/2 - 6 | Jan. 1918 | 1 | ... | ... | ... | ... | ... | 100 | ... | Butts 3 coats - tops 2 coats. |
| " " | Open tank: | Auburn, Alabama | 6-1/2 | " " | 14 | 100 | ... | ... | ... | ... | ... | ... | Piled on ground 2-1/2 years. Split posts - Entire post treated. |
| " " | " " | Clemson College, S. C. | 5-1/2 - 6 | " " | 17 | 76.4 | 5.9 | 5.9 | ... | 5.9 | 5.9 | ... | " " " " " |
| " " | " " | College Park, Md. | 6 | Nov. 1914 | 41 | 97.6 | 2.4 | ... | ... | ... | ... | ... | Single tank |
| " " | " " | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | |
| " " | Untreated: ... | " " " | 6 | " " | 5 | 100 | ... | ... | ... | ... | ... | ... | |
| Sassafras | " " | " " " | 6 | " " | 1 | 100 | ... | ... | ... | ... | ... | ... | |
| Spruce | Brush: Carbolineum | University Farm, Minn. | 4 | Nov. 1916 | 5 | 80.0 | ... | 20.0 | ... | ... | ... | ... | 2 coats. |
| " | Dip | " " " | 4 | " " | 9 | 44.4 | ... | 55.6 | ... | ... | ... | ... | 2 minute dip. |
| " | Brush: C. T. C. | " " " | 4 | " " | 3 | 66.7 | ... | 33.3 | ... | ... | ... | ... | 2 coats |
| " | Dip | " " " | 4 | " " | 6 | 33.3 | ... | 66.7 | ... | ... | ... | ... | 2 minute dip |
| " | Open tank: | " " " | 4 | " " | 18 | 33.3 | ... | 66.7 | ... | ... | ... | ... | Hot bath 2 hours. |
| " | " | " " " | 4 | " " | 3 | 33.3 | ... | 66.7 | ... | ... | ... | ... | Hot bath 1/2 hour Cold bath 3/4 hr. |
| " | Untreated: ... | " " " | 4 | " " | 15 | 80.0 | ... | 20.0 | ... | ... | ... | ... | |
| Spruce Engelmann | Brush: Crude oil | Fort Collins, Colorado | 8 | 1916 | 20 | 10.0 | ... | 40.0 | ... | 50.0 | ... | ... | 2 coats hot oil, 12 hours apart. Cut green - Seasoned. |
| " " | Open tank: C. T. C. | Routt County, Colorado | 1 | Sept. 1911 | 5 | 100 | ... | ... | ... | ... | ... | ... | Hot bath - over night cooling - Fire killed. Seasoned 27 years. |

[1] Posts set at Cleveland, Texas are M. P. & S. P. Ry. experiments. Data furnished by Mr. Geo. H. Rex, Manager, Treating Plants.

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THE PRESIDENT: This report, as Mr Gosline has stated, is merely a tabulation of data and facts. It occurs to me that there might be a good many members here who are in a position to make suggestions to the Committee, or offer some criticism, that would be of help to the Committee. We will now give you the opportunity.

MR. A. R. JOYCE: In connection with the report of the Committee on Service Tests, it is interesting to note the divergence of opinion among the wood-preservers, as to the kind and amount of treatment to be given ties. It is generally held that ties should be given sufficient treatment to prevent decay during the term of their mechanical life. On this point, one group of operators makes the statement that "the mechanical life of ties on our system is"—and then they detail it, and they say, "therefore the kind of treatment which we shall give ties will be"—and then they arrive at a certain conclusion. Another group of operators makes the statement that "under the service conditions of our systems, ties are failing mechanically"—therefore, this fact must be presented to the management fully, in order that steps may be taken to properly protect treated ties so that the full life of the treatment may be obtained.

In either event, such statements can only be made accurately by officers having full knowledge of the facts involved. It is generally conceded that accurate facts can be obtained better through the close observance of experimental stretches of track rather than through an attempt to keep a record of all ties in service.

In the final analysis, however, the maintenance of way records showing the annual renewals per mile per year, considered with due regard to the cost per tie, on a system where the trackage is adequately maintained, gives the answer as to the success or failure of the policies of the management in regard to tie renewals.

While facts obtained from experimental sections of track where ties are laid out of face, give valuable results, there may be a question in the minds of some operating officials as to whether the results obtained are the average results which may be expected on hundreds of thousands of ties so treated and installed.

I had the pleasure last year of inspecting a great many ties on one of the western trunk lines. I made some notes. Part of these ties were experimental ties, installed as such, various species of woods treated in various manners. Part of the ties were installed in the construction of new lines, not experimental tests at all, but average ties installed under average conditions.

Of the experimental ties we noted that the ties with straight creosote full cell had the best appearance, and ties treated with a mixture of zinc chloride and creosote were almost as good as straight

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creosote. This was after 6, 7, 8 or 9 years. The only difference between the ties treated with a mixture and ties treated with straight creosote was a slight tendency to check in the ties treated with a mixture. The zinc treated ties after 7 or 8 years showed up more surface checks and season cracks than either of the other two treatments. This is a very important fact and undoubtedly contributes to the failure of zinc-treated material in climates where the annual rainfall is a factor.

But aside from the experimental tracks which were installed as such, some very interesting facts were noticed. In one of the western states, in a track 14 miles long, constructed in 1900, zinc-treated lodge pole-pine ties were laid in gravel ballast, 75-lb. rail, no tie-plates except on curves. Rail changed in 1916 to 90-lb. at which time ties were cut with saws which were installed on a small handcar and adzed out between saw cuts for tie-plates. I had the pleasure of walking over two miles of this stretch of 14 miles that was laid out. These two miles were set aside and every tie counted. The ties were originally dated. On the basis of that count 93% of those zinc-treated ties have given to date 16 years' service. That is not experimental at all; it is average practice. The ties were treated in the ordinary way and installed under the ordinary conditions. The rail was changed this year and an occasional tie was removed. We examined closely a number of these ties, which showed no evidence of rot and no evidence of failure except for the rail cutting which was not serious enough to prevent these ties from being used again.

Just beyond this track 6 miles of fir ties untreated were laid in 1900 and the renewals began in 1905. All of these ties untreated had been removed by 1908. They failed on account of rot, and gave an average life of only 6 years. The normal annual rainfall for this track is 19 ins., and this compares with a normal annual rainfall in southern Illinois of 45 ins. and Northern Illinois of 40 inches. Then we went over a stretch of track of 90 miles. It was built in 1906. Ninety miles of track built in 1906 with zinc-treated fir and pine ties, and two miles of that 90 miles was set aside, and every tie was counted. In one of the miles one tie had been removed to date and in the other mile no ties had been removed to date, and on the entire 90 miles of these zinc-treated ties the renewals have been less than 600 ties in 10 years. That is for all causes, burn and breakage and derailment, or any cause whatsoever.

If the ties in these 90 miles of track should all fail in the eleventh year, the life of these zinc-treated ties has already proven the wisdom of their use, as the life which could be reasonably expected from untreated fir and pine in this climate is apparently 6 years.

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The normal annual rainfall for this stretch of track was from 10 to 14 inches. I think the normal annual rainfall statistics have a very important bearing in considering the records of zinc-treated ties.

When a man says zinc treatment, the question to ask him is what the normal annual rainfall is, and consider the two of them together.

A very interesting matter happened on one of these particular systems in relation to the lineup for the annual inspection of these tracks. The vice-president in charge of operation had issued instructions that on his annual trip of inspection the superintendent of timber preservation shall be accompanied by the division superintendent, the roadmaster and the section-foreman on each of these particular pieces of tracks, and also by a representative of the Maintenance-of-Way Department, an engineer. This establishes a community of interests, and each man acts as a check on the other, and the entire undertaking is carried on with due regard to its importance (applause).

MR. J. H. WATERMAN: Mr. Chairman, you have asked for suggestions for the Committee. I have a suggestion to make. The American Railway Engineering Association compiles statistics something like those presented. They usually send a man over one or more stretches of experimental tracks to examine the tracks, with the representative on that road. Now you know there is a long list here, and it refers to the Burlington system. I want to give one member of this Committee, that is, I would like to have this Committee select a member and I will give him a very cordial invitation to accompany me this year over any or all of the Burlington experimental tracks, and then he can see for himself. Sometimes we see things through our own eyes, and we get so enthusiastic we only see one side of it, and it is, I think, a nice thing to have a representative from this organization accompany, or go over part or all of the experimental sections. The Committee can divide it up among a number of the railroads represented here. I am not inviting members to go over the other roads, but I suggest it is a good proposition. If the member you elect to go with me will get in touch with me next August I will give you a timetable so you can know where I will be and on what dates.

THE PRESIDENT: If representatives of the different railroads who have experimental tracks will get in touch with our Committee and help them along such lines as Mr. Waterman, representing the Burlington, has offered to help them, it will certainly be of great assistance to our Committee and to our Association in collecting data, which is perhaps the most interesting data that we can put out to people who are considering treating timber.

MR. L. B. MOSES: I wonder if Mr. Joyce can tell us in connection with these reports on mountain pine in the 14-mile stretch he spoke.

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of, whether these ties were tie-plated, and if so the dimensions of the tie-plates and weight of the rail.

MR. A. R. JOYCE: The ties were tie-plated on curves only. The plates were rather small. The ties all show evidence of rail cut. The original rail on most of this track was 75 pounds. It has since been changed to 90 pounds, and in talking with some of the roadmasters they seem to think that many of the ties that have failed, failed because they had not been properly protected. Now when you come to consider on the first stretch of track that 93% of those ties have already gone 16 years, and that at least 50% are going to go 20 years, when you talk about 7% that failed, the failure is so small it is pretty hard to tell just what effect the rail-cutting has. On tangents there were no tie-plates, and the original rail was 75 pounds.

MR. NELSON C. BROWN: Mr. President, I would like to ask Mr. Joyce what species of pine is that mountain pine he speaks of, and where it is cut?

MR. A. R. JOYCE: It is cut in the Black Hills and Big Horn Mountains.

MR. NELSON C. BROWN: That is the western yellow pine then?

MR. A. R. JOYCE: It is both lodgepole and western yellow pine.

THE PRESIDENT: Any further remarks? What action do you wish to take on this Committee's report?

MR. J. H. WATERMAN: I move you that the Committee's report be accepted, and we compliment them on the work they have done, and continue the same Committee, or not necessarily the same Committee, but continue a Committee on the same lines the next year.

THE PRESIDENT: Is there a second?

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. H. M. ROLLINS: I would like to refer back to this report of the Committee. On page 88 you will notice a table at the top of the page.

THE PRESIDENT: What report is it, Mr. Rollins?

MR. H. M. ROLLINS: It is the report you have just received on Service Tests. I want to call your attention to a typographical error at the top of page 88, under the heading of "Ash Ties." You will notice in the bottom line, "Untreated, total ties placed, 116, total ties removed, 193."

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MR. F. J. ANGIER: We will make a correction there, Mr. Rollins. That is a printer's error, probably.

THE PRESIDENT: We will now have the report of the Committee on Plant Operation. I will ask the Secretary to read the names.

SECRETARY ANGIER: Mr. A. L. Kuehn, Chairman, Mr. Geo. M. Hunt, Mr. C. W. Lane, Mr. A. M. Lockett, Mr. Frank McArdle and Mr. August Meyer.

MR. A. L. KUEHN: We started here to make a little classification of the operations of a plant. We have to remember that such a thing is necessary to properly and systematically work out any standards or rules for plant operation. This can be readily carried on and be made a basis for accounting classifications. That, of course, is one of our important items. This is simply submitted as progress and information. The next three items, under "Methods of Measuring Quantities," "Plant Records" and "Methods of Determining Cubic Feet of Wood in a Charge," are submitted as progress and information, excepting that the Committee recommends for adoption and recommended practice the table on page 242. This table is the standard table for expansion of creosote, based on the unit volume at 100° F., and an expansion of 1% for every 22½° F. This is a table that I believe everybody is familiar with; it is old material, but I think that makes it ever so much more necessary to put it in the MANUAL OF RECOMMENDED PRACTICE. In addition to that table there is one item which was intended to be given as recommended for adoption, and we would like to submit that now, that is, that the standard measuring temperature for creosote oil be 100°. I would like to ask Mr. Hunt to lead the discussion on calculating the volume of poles and piles.

MR. GEO. M. HUNT: In looking up methods for calculating the volume of poles and piles, we came across a large number of methods. Some of the principal ones are described here, and the difference in results that you can get are noted.

On account of the fact that a pile or a pole is not uniform or regular in shape, you cannot expect to get the exact volume by any method which is practicable in a commercial treating plant where you are handling large numbers. You, therefore, have to use a method which is practicable and which will give you the nearest results to the correct one. We feel that the table on page 249 calculated by the formula given underneath it is the one which is the most practicable for general treating plant use. If in special cases anyone wants more accurate results, about the only thing he can do is to divide his pile up into short sections, that is, mark it off into short sections, and measure the diameter or the circumference at each end of each section, and then calculate those sections as separate pieces of wood, and get the

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total. The shorter you make those sections and the more careful are your measurements, the more nearly the exact results you will get.

For general work we believe the table will give you what you want. It is recommended by the Committee that this table be adopted to be printed in the MANUAL as recommended practice and recommended usage for the Association.

MR. A. L. KUEHN: The last item is with reference to Fuel and Power Consumption, and is a paper written by Mr. Lockett. We present this as information and for study.

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## REPORT OF COMMITTEE ON PLANT OPERATION.

*To the Members of the American Wood-Preservers' Association:*

The objects we wish to attain in the working of the plant are: First, good work; second, economical and efficient operation. These ends can be obtained only by study of the details of the operation. For such a study it is necessary to make a detailed classification of the various steps together with the various means of performing these steps. It is attempted here to present such a classification for criticism and further amplification.

In general, the work at a wood-preserving plant is grouped as follows:

1. Receiving and storage of material to be treated.
2. Transportation of the material.
3. Special manufacturing.
4. Steam and power generation.
5. Treating.
6. Shipping.
7. Keeping of records and accounting.

It must be remembered in studying various methods of performing any step that greatly varying conditions are to be met for various plants. It is, therefore, essential that the best manner of applying each method be studied rather than making general comparison of all methods. When the best way of working each method is known, the proper method for any particular case can readily be determined.

**1. Receiving and Storage of Material to be Treated.**

- *a.* Entirely by manual labor.
- *b.* By special conveyors.
- *c.* By locomotive crane.
- *d.* By fixed derrick.

**2. Transporting Material.**

- *a.* Loading of tram cars by hand, locomotive crane, conveyor, fixed derrick.

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*b.* Transporting by cable, special steam locomotive, electric locomotive.

3. **Special Manufacturing.**
   - *a.* Paving blocks.
   - *b.* Boring and adzing of ties.
   - *c.* Framing of poles.
   - *d.* Manufacture of cross-arms.
   - *e.* Framing of timbers.

4. **Steam and Power Generation.**
   - *a.* Fuel supply, proper selection of fuel.
   - *b.* Boiler operation.
   - *c.* Water supply.
   - *d.* Electric power generation.

5. **Treating.**
   - *a.* Charging and discharging of retorts.
   - *b.* Pumping preservatives, by steam pump, by centrifugal pump, by air.
   - *c.* Storage and measuring of preservatives.
   - *d.* Operation of air, vacuum and pressure pumps.
   - *e.* Heating.

6. **Shipping.**

   Loading of material by hand, conveyors, locomotive crane fixed derrick.

7. **Keeping of Records.**
   - *a.* Recording of the steps at time of performance.
   - *b.* Compiling and reporting operations.

## METHODS OF MEASURING QUANTITIES OF PRESERVATIVE USED AND THE MAKING OF INVENTORIES.

**By August Meyer.**

A correct checking of inventories on creosote can be obtained either by weighing or by measuring. However, where large quantities of creosote are on hand it would be a very difficult job to weigh out except when special arrangements are provided, and for this reason we are obliged in most cases to take inventories of creosote by measurements. In order to do so we must obtain the following four factors for our calculation, namely:

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1. The exact area of the tank containing the creosote.
2. The exact measurement of volume.
3. The temperature.
4. The coefficient of expansion.

To obtain the correct measurement of a quantity of creosote in a tank it is not advisable to rely on a gauge reading alone even if we have a good assurance that the gauge is correct. We must check this gauge reading.

The matter of obtaining the correct mean temperature of a tank of creosote is most important. Since the standard measuring temperature is now generally accepted as 100° F., it is desirable to measure a volume of creosote as nearly as possible at this temperature since

FACTORS TO BE USED FOR DETERMINING THE VOLUME OF CREOSOTE AT 100° F., WHEN THE OIL IS AT TEMPERATURES RANGING FROM 60° TO 225° F.

| Temp. Fahr. | Factor. | Temp. Fahr. | Factor. | Temp. Fahr. | Factor. | Temp. Fahr. | Factor. |
|---|---|---|---|---|---|---|---|
| 60 | 0.9822 | 102 | 1.0009 | 144 | 1.0196 | 186 | 1.0382 |
| 1 | 0.9827 | 3 | 1.0013 | 5 | 1.0200 | 7 | 1.0387 |
| 2 | 0.9831 | 4 | 1.0018 | 6 | 1.0204 | 8 | 1.0391 |
| 3 | 0.9836 | 5 | 1.0022 | 7 | 1.0209 | 9 | 1.0396 |
| 4 | 0.9840 | 6 | 1.0027 | 8 | 1.0213 | 190 | 1.0400 |
| 5 | 0.9845 | 7 | 1.0031 | 9 | 1.0218 | 1 | 1.0404 |
| 6 | 0.9849 | 8 | 1.0036 | 150 | 1.0222 | 2 | 1.0409 |
| 7 | 0.9853 | 9 | 1.0040 | 1 | 1.0227 | 3 | 1.0413 |
| 8 | 0.9858 | 110 | 1.0045 | 2 | 1.0231 | 4 | 1.0418 |
| 9 | 0.9862 | 1 | 1.0049 | 3 | 1.0236 | 5 | 1.0422 |
| 70 | 0.9867 | 2 | 1.0053 | 4 | 1.0240 | 6 | 1.0427 |
| 1 | 0.9871 | 3 | 1.0058 | 5 | 1.0245 | 7 | 1.0431 |
| 2 | 0.9876 | 4 | 1.0062 | 6 | 1.0249 | 8 | 1.0436 |
| 3 | 0.9880 | 5 | 1.0067 | 7 | 1.0253 | 9 | 1.0440 |
| 4 | 0.9885 | 6 | 1.0071 | 8 | 1.0258 | 200 | 1.0445 |
| 5 | 0.9889 | 7 | 1.0076 | 9 | 1.0262 | 1 | 1.0449 |
| 6 | 0.9894 | 8 | 1.0080 | 160 | 1.0267 | 2 | 1.0453 |
| 7 | 0.9898 | 9 | 1.0085 | 1 | 1.0271 | 3 | 1.0458 |
| 8 | 0.9902 | 120 | 1.0089 | 2 | 1.0276 | 4 | 1.0462 |
| 9 | 0.9907 | 1 | 1.0094 | 3 | 1.0280 | 5 | 1.0467 |
| 80 | 0.9911 | 2 | 1.0098 | 4 | 1.0285 | 6 | 1.0471 |
| 1 | 0.9916 | 3 | 1.0102 | 5 | 1.0289 | 7 | 1.0476 |
| 2 | 0.9920 | 4 | 1.0107 | 6 | 1.0294 | 8 | 1.0480 |
| 3 | 0.9925 | 5 | 1.0111 | 7 | 1.0298 | 9 | 1.0485 |
| 4 | 0.9929 | 6 | 1.0116 | 8 | 1.0302 | 210 | 1.0489 |
| 5 | 0.9934 | 7 | 1.0120 | 9 | 1.0307 | 1 | 1.0494 |
| 6 | 0.9938 | 8 | 1.0125 | 170 | 1.0311 | 2 | 1.0498 |
| 7 | 0.9943 | 9 | 1.0129 | 1 | 1.0316 | 3 | 1.0502 |
| 8 | 0.9947 | 130 | 1.0134 | 2 | 1.0320 | 4 | 1.0507 |
| 9 | 0.9951 | 1 | 1.0138 | 3 | 1.0325 | 5 | 1.0511 |
| 90 | 0.9956 | 2 | 1.0143 | 4 | 1.0329 | 6 | 1.0516 |
| 1 | 0.9960 | 3 | 1.0147 | 5 | 1.0334 | 7 | 1.0520 |
| 2 | 0.9965 | 4 | 1.0151 | 6 | 1.0338 | 8 | 1.0525 |
| 3 | 0.9969 | 5 | 1.0156 | 7 | 1.0343 | 9 | 1.0529 |
| 4 | 0.9974 | 6 | 1.0160 | 8 | 1.0347 | 220 | 1.0533 |
| 5 | 0.9978 | 7 | 1.0165 | 9 | 1.0351 | 1 | 1.0538 |
| 6 | 0.9983 | 8 | 1.0169 | 180 | 1.0355 | 2 | 1.0542 |
| 7 | 0.9987 | 9 | 1.0174 | 1 | 1.0360 | 3 | 1.0547 |
| 8 | 0.9992 | 140 | 1.0178 | 2 | 1.0365 | 4 | 1.0551 |
| 9 | 0.9996 | 1 | 1.0183 | 3 | 1.0369 | 5 | 1.0556 |
| 100 | 1.0000 | 2 | 1.0187 | 4 | 1.0373 | ... | ..... |
| 1 | 1.0004 | 3 | 1.0192 | 5 | 1.0378 | ... | ..... |

Explanation: To determine the volume at 100° F., divide the volume at any temperature by the factor corresponding to that temperature in the above table.

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this reduces the errors due to expansion correction. However, it is usually necessary to heat the oil higher than 100° F. in order to be sure that the entire volume is liquid. It is most important that enough observations of temperature be taken to get as nearly as possible the true average temperature.

It is important in order to arrive at true volumes that the creosote measured is liquid. It is impossible, however, to liquefy sludge which has settled in the bottom of the storage tanks, and it is, therefore, desirable to have some simple stirring or agitating arrangement, so that this sludge may be kept dissolved. It is also desirable, therefore, to have heating coils as near as possible to the tank bottom.

As stated, in order to make an accurate measurement, the coefficient of expansion should be fairly accurately known, This coefficient will vary for various oils and mixtures. The expansion coefficient of creosote is closely 0.00044, and below is a table of coefficients based on the volume at 100° F.

For other solutions such as zinc chloride the number of cubic feet of solution in a tank must first be found in the same manner as for creosote. After this is done the weight per cubic foot and the strength of the solution must be determined.

There are several ways to determine the weight per cubic foot of a solution, either by weighing a cubic foot direct or by finding its specific gravity by means of a specific gravity bottle or a hydrometer.

The strength of a solution is determined either by chemical analysis or by hydrometers made especially for this kind of work, and various tables giving the strength of a solution at different temperatures can easily be obtained, for example, the tables made by Samuel Rowe & Son, and others. Having obtained the number of cubic feet of solution in the tank, its weight per cubic foot and strength, the number of pounds of dry zinc chloride this solution contains will be known.

## PLANT RECORDS.

### By August Meyer.

Correct records covering the operation of a plant seems to me a matter which must be left to the management of each individual plant to solve, because few commercial plants are operated under similar conditions and it is a fact that a private plant will never require the same records as a plant owned and operated by a railroad. There are, however, certain records which ought to be kept at every timber-treating plant. These records should cover everything pertaining to the material treated, such as date received in yard, condition of material,

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either seasoned or unseasoned, time of storage in yard, when it was treated, by what process, the condition of the material before and after treatment, a treating report giving in detail the whole operations of the treatment and last, but not least, all comments from the owners of the material and the management of the plant. To illustrate:

Very often an operator is called upon to treat material which is not in the proper condition for treatment, or perhaps is asked to give this material a treatment which will do it more harm than good, and although there may be objections against it at the time, still the material is treated over the operator's objections and a few years later when the material fails the operator of the plant will be blamed because he cannot bring forth the records which show who in reality is to blame for the unsuccessful treatment.

## METHODS OF DETERMINING CUBIC FEET OF WOOD IN A CHARGE.

**By August Meyer.**

There are three methods by which we may arrive at the approximate number of cubic feet in a charge, namely:

(1.) By displacement in retort.
(2.) By weighing.
(3.) By measuring.

The first, and perhaps the best known method for determining the number of cubic feet in a charge, seems very unreliable on account of the irregularity by which a charge of timber absorbs the preservatives during filling.

The second method is to weigh and measure a certain number of ties and from the figures obtained calculate the average weight per cubic foot. By weighing each charge before treating, using the average weight per cubic foot as a base for calculating the number of cubic feet, a fair result may be obtained providing all the ties to be treated have the same amount of seasoning, are of the same kind of wood, and weather conditions remain the same. If this is not the case, very erroneous results may also be obtained by this method. There is, of course, one good point in using this method which ought not to be overlooked, and that is by weighing the charge again after treating, a check on the actual absorption is obtained.

The third method, which seems the most practical and by which the most reliable information can be obtained, is to measure a large number of ties after they are loaded on trams and from the figures thus obtained calculate the average number of cubic feet per tie and per tram and use these results as an arbitrary figure for each charge. The larger the number of ties measured of the different kinds of wood, the more reliable will be the result.

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## CALCULATING THE VOLUME OF POLES AND PILES.

By Geo. M. Hunt.

There are a number of ways to obtain the volume of poles, piles, and other round timbers. The most accurate way would be to submerge the pile in some substance which would fill all the checks, but would not be absorbed by the wood. This, of course, is in general impracticable, and for ordinary treating plant work the simplest way is to measure the diameter at a number of points and calculate the volume from a formula or a volume table.

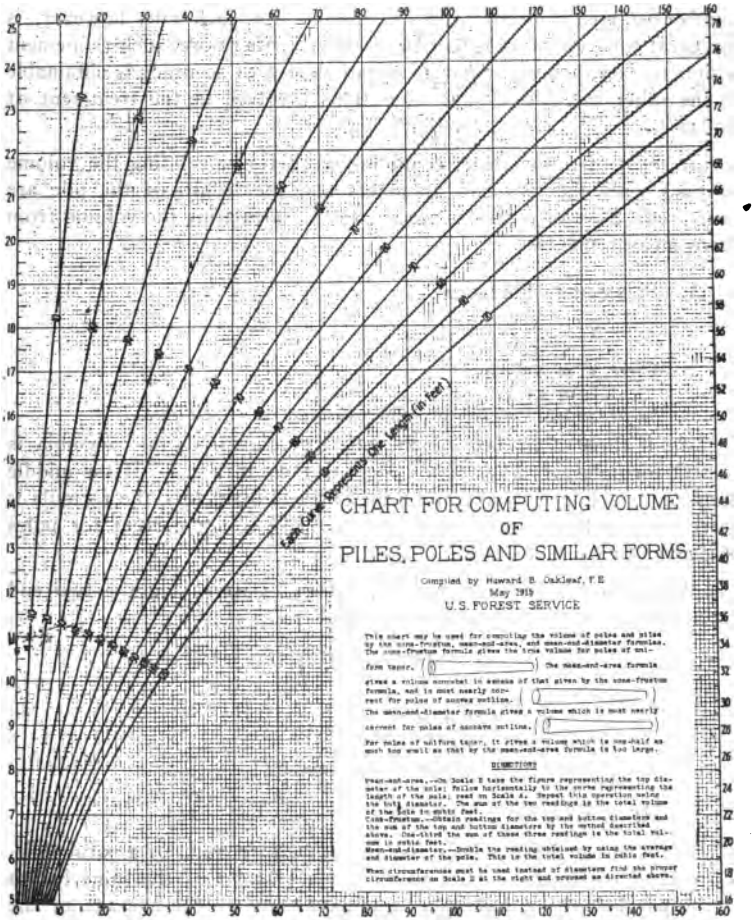


Fig. 1.

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A number of possible errors are introduced in obtaining the volume from these measurements. In the first place, the pile is assumed to be round, which is seldom the case. It is also assumed that there are no irregularities in its contour between the points at which the measurements are taken, and no allowance is made for checks so that in the case of seasoned timber the volume of all checks is calculated as wood.

If the circumference measurements are taken at short intervals and the volume of each short section is computed separately the greatest degree of accuracy is obtained. The inconvenience of making a large number of measurements and calculations for each pile, however, is too great for ordinary commercial work. Furthermore, such refinement is unnecessary, because only a moderate degree of accuracy is obtainable in the other calculations and operations involved in the treatment of timber.

In most of the methods commonly used for calculating the volume of piles, only the two end diameters and the length of the pile are measured. Several formulas are in use for calculating the volume from these measurements.

1. PRISMOIDAL FORMULA:

$$V = \frac{L}{6}(A_1 + 4Am + A_2.)$$

Where V = Volume.
L = Length.
$A_1$, $A_2$, and Am = The two end areas and the middle area.

If all three diameters of the pile are measured, this formula is correct for poles of either of the shapes shown in Fig. 1. If the middle diameter is obtained by averaging the two end diameters, the formula is correct for poles of uniform taper only and is not correct for poles of convex or concave outline.

When the middle diameter is obtained by averaging the two end diameters the formula may be simplified to:

$$V = 0.2618\ L\ \left(\frac{D_2 + d_2 + Dd}{144}\right)$$

In which V = Volume.
L = Length in feet.
D = Butt diameter in inches.
d = Top diameter in inches.
This is correct for the frustum of a cone.

2. MEAN END AREA FORMULA:

In this method the pole is assumed to be a frustum of a paraboloid, the volume of which is equal to that of a cylinder of the same length as the paraboloid but having a basal area equal to the average of the areas of its two ends. The formula is:

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$$V = L \left(\frac{A_1+A_2}{2}\right)$$

In which L = Length.
$A_1$ and $A_2$ = The two end areas.

The volume of the pole can be calculated by this formula in less than half the time required by the prismoidal formula, but the values obtained are always somewhat greater than by the prismoidal formula. This value is most nearly correct for piles of convex outline. It has been found that where the small diameter is greater than 0.78 of the large diameter the volume by the mean area formula will differ by less than 1% from the volume by the cone frustum formula. (See Table 1.)

3. MEAN END DIAMETER FORMULA:

In this method the volume of the pile is assumed to be equivalent to that of a cylinder of the same length and a diameter equal to the average of two end diameters of the pile. The formula may be expressed as follows:

$$V = \overline{11}\ L \left(\frac{d}{2^*}\right)^2$$

$$= \frac{\overline{11}\ L\ d^2}{4}$$

$$= .7854\ L\ d^2$$

In which L = Length.
d = Mean diameter.

This formula is easier to use than the mean end area formula and the results obtained are nearer to the results given by the cone frustum formula. It gives a volume which is always less than that obtained by the cone frustum formula, but differs from it by only one half as much as the values given by the mean end formula. It is most nearly correct for poles of a concave outline. Where the small diameter is greater than 0.70 of the large diameter, the results by this method differ by less than 1% from the results by the cone frustum formula (see Table 1.)

At one plant, the diameters are measured at 1/3 and 2/3 of the distance from one end, in addition to the two end diameters. The four diameters can then be averaged and the mean diameter used in the above formula. The result should be more accurate than that obtained by averaging the two end diameters only.

On account of the more or less irregular shape of piles and poles, no formula for a regular shaped solid can be expected to give the exact volume of an individual pile or pole. Either of the above formulas, however, will generally give results sufficiently close for ordinary purposes, unless the top diameter is very much smaller than the butt diameter.

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Table 1 shows the relation between the volumes obtained by Formulas 1, 2, and 3, for poles varying from a true cone to a true cylinder. The volume by the cone frustum formula is taken as unity in each case in the table. The volume by either of the other formulas may be obtained by multiplying the volume given by the cone frustum formula by the factor given under the respective formula. The table shows that where the top diameter is very much smaller than the butt diameter the three formulas give widely varying results. As the top diameter becomes more nearly equal to the butt diameter, however, the three formulas give results which are more nearly the same.

The volume table (Table 2) which follows was calculated by the cone frustum formula (No. 1). If more accurate results are required, the pile should be laid off in a number of short sections, and the volume of each section calculated.

In measuring diameters it will frequently be found that the end of the pile is not a true circle. A figure representing as nearly as possible the average diameter of the end should be taken.

TABLE I.—RELATION OF VOLUME BY MEAN END AREA AND MEAN END DIAMETER FORMULAS TO THAT BY CONE FRUSTUM FORMULA.

| Ratio of Top Diameter to Butt Diameter | FACTORS FOR | | |
|---|---|---|---|
| | Cone Frustum Formula. | Mean End Area Formula. | Mean End Diameter Formula. |
| 0.0 | 1.00 | 1.500 | 0.750 |
| .1 | 1.00 | 1.360 | .820 |
| .2 | 1.00 | 1.260 | .870 |
| .3 | 1.00 | 1.180 | .910 |
| .4 | 1.00 | 1.120 | .940 |
| .5 | 1.00 | 1.070 | .960 |
| .6 | 1.00 | 1.040 | .980 |
| .7 | 1.00 | 1.020 | .990 |
| .8 | 1.00 | 1.008 | .996 |
| .9 | 1.00 | 1.002 | .999 |
| 1.0 | 1.00 | 1,000 | 1,000 |

The curves shown in Fig. 1, which were prepared by H. B. Oakleaf of the Forest Service, give the volume by all three methods described above.

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Find the average diameter at each end of the pile to the nearest half inch. Multiply the number in the table corresponding to these two diameters by the length of the pile in feet. The result is in cubic feet.

AVERAGE VOLUME PER FOOT OF LENGTH (Cubic Feet).

DIAMETER OF LARGE END—INCHES.

DIAMETER OF SMALL END—INCHES.

| | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 10½ | 11 | 11½ | 12 | 12½ | 13 | 13½ | 14 | 14½ | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | .087 | | | | | | | | | | | | | | | | | | | | | | |
| 4½ | .099 | .110 | | | | | | | | | | | | | | | | | | | | | |
| 5 | .111 | .123 | .136 | | | | | | | | | | | | | | | | | | | | |
| 5½ | .124 | .137 | .150 | .165 | | | | | | | | | | | | | | | | | | | |
| 6 | .138 | .151 | .165 | .180 | .196 | | | | | | | | | | | | | | | | | | |
| 6½ | .153 | .167 | .181 | .197 | .213 | .230 | | | | | | | | | | | | | | | | | |
| 7 | .169 | .183 | .198 | .214 | .231 | .249 | .267 | | | | | | | | | | | | | | | | |
| 7½ | .186 | .200 | .216 | .232 | .250 | .268 | .287 | .307 | | | | | | | | | | | | | | | |
| 8 | .204 | .219 | .235 | .251 | .269 | .288 | .307 | .328 | .349 | | | | | | | | | | | | | | |
| 8½ | .222 | .238 | .254 | .271 | .290 | .309 | .329 | .350 | .371 | .394 | | | | | | | | | | | | | |
| 9 | .242 | .258 | .275 | .292 | .311 | .330 | .351 | .372 | .395 | .418 | .442 | | | | | | | | | | | | |
| 9½ | .262 | .279 | .296 | .314 | .333 | .353 | .374 | .396 | .419 | .442 | .467 | .492 | | | | | | | | | | | |
| 10 | .284 | .300 | .318 | .337 | .356 | .377 | .398 | .420 | .444 | .468 | .493 | .519 | .545 | | | | | | | | | | |
| 10½ | .306 | .323 | .341 | .360 | .380 | .401 | .423 | .446 | .470 | .494 | .520 | .546 | .573 | .601 | | | | | | | | | |
| 11 | .329 | .347 | .365 | .385 | .405 | .427 | .449 | .472 | .496 | .521 | .547 | .574 | .602 | .630 | .660 | | | | | | | | |
| 11½ | .353 | .371 | .390 | .410 | .431 | .453 | .476 | .500 | .524 | .550 | .576 | .603 | .631 | .660 | .690 | .721 | | | | | | | |
| 12 | .378 | .397 | .416 | .437 | .458 | .480 | .504 | .528 | .553 | .579 | .605 | .633 | .662 | .691 | .722 | .753 | .785 | | | | | | |
| 12½ | .404 | .423 | .443 | .464 | .486 | .509 | .532 | .559 | .582 | .609 | .636 | .664 | .693 | .723 | .754 | .786 | .819 | .852 | | | | | |
| 13 | .431 | .450 | .471 | .492 | .515 | .538 | .562 | .587 | .613 | .640 | .667 | .696 | .725 | .756 | .787 | .819 | .853 | .887 | .922 | | | | |
| 13½ | .459 | .479 | .500 | .521 | .544 | .568 | .592 | .618 | .644 | .671 | .700 | .729 | .759 | .790 | .821 | .854 | .888 | .922 | .958 | .994 | | | |
| 14 | .487 | .508 | .529 | .551 | .575 | .599 | .624 | .650 | .676 | .704 | .733 | .762 | .793 | .824 | .856 | .890 | .924 | .959 | .994 | 1.031 | 1.069 | | |
| 14½ | .517 | .538 | .560 | .582 | .606 | .630 | .656 | .682 | .710 | .738 | .767 | .797 | .828 | .860 | .892 | .926 | .960 | .996 | 1.032 | 1.069 | 1.108 | 1.147 | |
| 15 | .547 | .569 | .591 | .614 | .638 | .663 | .689 | .716 | .744 | .772 | .802 | .832 | .864 | .896 | .929 | .963 | .998 | 1.034 | 1.071 | 1.109 | 1.147 | 1.187 | 1.227 |
| 15½ | .579 | .600 | .623 | .647 | .671 | .697 | .723 | .750 | .779 | .808 | .838 | .869 | .900 | .933 | .967 | 1.001 | 1.037 | 1.073 | 1.110 | 1.149 | 1.188 | 1.228 | 1.269 |
| 16 | .611 | .633 | .656 | .680 | .705 | .731 | .758 | .786 | .815 | .844 | .875 | .906 | .938 | .971 | 1.005 | 1.040 | 1.076 | 1.113 | 1.151 | 1.189 | 1.229 | 1.269 | 1.311 |
| 16½ | .644 | .667 | .690 | .715 | .740 | .767 | .794 | .822 | .851 | .881 | .912 | .944 | .977 | 1.010 | 1.045 | 1.080 | 1.117 | 1.154 | 1.192 | 1.231 | 1.271 | 1.312 | 1.354 |
| 17 | .678 | .701 | .725 | .750 | .776 | .803 | .831 | .860 | .889 | .920 | .951 | .983 | 1.015 | 1.050 | 1.085 | 1.121 | 1.158 | 1.196 | 1.234 | 1.274 | 1.314 | 1.356 | 1.398 |
| 17½ | .713 | .737 | .761 | .787 | .813 | .840 | .869 | .898 | .928 | .959 | .990 | 1.023 | 1.057 | 1.091 | 1.127 | 1.163 | 1.200 | 1.239 | 1.278 | 1.318 | 1.359 | 1.400 | 1.443 |
| 18 | .749 | .773 | .798 | .824 | .851 | .879 | .907 | .937 | .967 | .999 | 1.031 | 1.064 | 1.098 | 1.133 | 1.169 | 1.206 | 1.244 | 1.282 | 1.322 | 1.362 | 1.404 | 1.446 | 1.489 |
| 18½ | .786 | .810 | .836 | .862 | .890 | .918 | .947 | .977 | 1.008 | 1.039 | 1.072 | 1.106 | 1.140 | 1.176 | 1.212 | 1.249 | 1.288 | 1.327 | 1.367 | 1.408 | 1.449 | 1.492 | 1.536 |
| 19 | .824 | .849 | .875 | .901 | .929 | .958 | .987 | 1.018 | 1.049 | 1.081 | 1.114 | 1.149 | 1.184 | 1.219 | 1.256 | 1.294 | 1.333 | 1.372 | 1.413 | 1.454 | 1.496 | 1.539 | 1.584 |
| 19½ | .862 | .888 | .914 | .941 | .969 | .999 | 1.029 | 1.059 | 1.091 | 1.124 | 1.158 | 1.192 | 1.228 | 1.264 | 1.301 | 1.339 | 1.379 | 1.419 | 1.459 | 1.501 | 1.544 | 1.588 | 1.632 |
| 20 | .902 | .928 | .955 | .982 | 1.011 | 1.040 | 1.071 | 1.102 | 1.134 | 1.168 | 1.202 | 1.237 | 1.273 | 1.309 | 1.347 | 1.386 | 1.425 | 1.466 | 1.507 | 1.549 | 1.593 | 1.637 | 1.682 |
| 20½ | .942 | .969 | .996 | 1.024 | 1.053 | 1.083 | 1.114 | 1.146 | 1.179 | 1.212 | 1.247 | 1.282 | 1.319 | 1.356 | 1.394 | 1.433 | 1.473 | 1.514 | 1.556 | 1.599 | 1.642 | 1.687 | 1.732 |
| 21 | .984 | 1.010 | 1.038 | 1.067 | 1.096 | 1.127 | 1.158 | 1.190 | 1.224 | 1.258 | 1.293 | 1.329 | 1.365 | 1.403 | 1.442 | 1.481 | 1.522 | 1.563 | 1.605 | 1.649 | 1.693 | 1.738 | 1.784 |
| 21½ | 1.026 | 1.053 | 1.081 | 1.110 | 1.140 | 1.171 | 1.203 | 1.236 | 1.269 | 1.304 | 1.339 | 1.376 | 1.413 | 1.451 | 1.490 | 1.530 | 1.571 | 1.613 | 1.656 | 1.699 | 1.744 | 1.789 | 1.836 |
| 22 | 1.069 | 1.097 | 1.125 | 1.155 | 1.185 | 1.217 | 1.249 | 1.282 | 1.316 | 1.351 | 1.387 | 1.424 | 1.462 | 1.500 | 1.540 | 1.580 | 1.622 | 1.664 | 1.707 | 1.751 | 1.796 | 1.842 | 1.889 |
| 22½ | 1.113 | 1.141 | 1.170 | 1.200 | 1.231 | 1.263 | 1.296 | 1.329 | 1.364 | 1.399 | 1.436 | 1.473 | 1.511 | 1.550 | 1.590 | 1.631 | 1.673 | 1.716 | 1.759 | 1.804 | 1.849 | 1.896 | 1.943 |
| 23 | 1.158 | 1.187 | 1.216 | 1.247 | 1.278 | 1.310 | 1.344 | 1.378 | 1.413 | 1.449 | 1.485 | 1.523 | 1.562 | 1.601 | 1.642 | 1.683 | 1.725 | 1.769 | 1.813 | 1.858 | 1.903 | 1.950 | 1.998 |
| 23½ | 1.204 | 1.233 | 1.263 | 1.294 | 1.326 | 1.359 | 1.392 | 1.427 | 1.462 | 1.499 | 1.536 | 1.574 | 1.613 | 1.653 | 1.694 | 1.736 | 1.779 | 1.822 | 1.867 | 1.912 | 1.958 | 2.006 | 2.054 |
| 24 | 1.251 | 1.280 | 1.311 | 1.342 | 1.374 | 1.408 | 1.442 | 1.477 | 1.513 | 1.549 | 1.587 | 1.626 | 1.665 | 1.706 | 1.747 | 1.789 | 1.833 | 1.877 | 1.922 | 1.968 | 2.014 | 2.062 | 2.111 |
| 24½ | 1.299 | 1.329 | 1.359 | 1.391 | 1.424 | 1.458 | 1.492 | 1.528 | 1.564 | 1.601 | 1.639 | 1.679 | 1.719 | 1.759 | 1.801 | 1.844 | 1.888 | 1.932 | 1.978 | 2.024 | 2.071 | 2.119 | 2.168 |
| 25 | 1.347 | 1.378 | 1.409 | 1.441 | 1.474 | 1.509 | 1.544 | 1.579 | 1.616 | 1.654 | 1.693 | 1.732 | 1.773 | 1.814 | 1.856 | 1.899 | 1.943 | 1.988 | 2.034 | 2.081 | 2.129 | 2.178 | 2.227 |

**FORMULA:** $\frac{D^2+d^2+Dd}{144} \times 0.2618 = (D^2+d^2+Dd) \times 0.001818$

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## FUEL AND POWER CONSUMPTION CONTROL.

**By A. M. Lockett.**

It would be well to preface these suggestions with some remarks bearing upon the general proposition of plant operation.

The objects and purposes of the American Wood-Preservers' Association are, as I understand them, to further the interests of its members by increasing the use of treated materials and enabling the members to meet the demand at a minimum cost.

To accomplish this purpose most effectively the members of the Association should fully realize the value of cooperation, not only in publicity work intended to increase the use of treated material, but in devising ways of improving the quality and reducing the cost of such materials, since quality and first cost are the most potent factors in increasing the demand for these materials.

It is manifest that if treated timber could be purchased at a mere nominal advance over the cost of untreated timber practically all work would be constructed of treated materials, and in line with this method of reasoning, while it is not possible to reduce the price of treated materials to a mere nominal advance over the price of untreated materials, it follows that the nearer these prices come together the greater will be the consumption.

To accomplish the best results plant managers should frankly and freely interchange information so that the best practice in each stage of operation can be generally adopted.

At first sight such a suggestion may strike some members unfavorably, because an individual who has succeeded in reducing his costs below his competitors, at some stage of the process may not feel inclined to give his competitors the benefit of his experience, but this individual would do well to remember that while he may have an edge on his competitors in one or two details the chances are very much against his having anything on the combined brains of the Association, and he will, no doubt, gain much more than he will lose by subscribing to the policy suggested.

It goes without saying that the ideal condition for the wood-preserving industry as a whole would be reached when every plant engaged in this work will have corrected all its shortcomings and brought its equipment and its manner of operation up to the maximum of efficiency so that there will be no difference in costs in the various plants except those due to location with respect to fuel, raw materials and the market; and if along with this the members of the Association will have reached that stage of business education which causes a man to adhere to the principle of selling no goods below the point where a fair profit is obtained the practice of naming prices below the proper figures in

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any specific case would automatically disappear without the need of any unlawful agreements.

It has been only in recent years that the most progressive manufacturers have learned the way to arrive at their true costs of production. This has been brought about largely by the interchange of information between members of trade associations, and the more freely the interchange is exercised the more quickly are results obtained.

Time was when these associations simply got together and agreed upon selling prices and since this could be done there was no great incentive to improvement in processes nor the reduction in cost; but now that agreements as to selling prices are unlawful these associations strive to acquaint their members with the true methods for arriving at their costs under the belief that a clear knowledge of costs will stabelize selling prices since all successful business men in any particular line will endeavor to obtain about the same margin of profit.

The writer has never operated a wood-preserving plant, or had access to the books of any plant for a period of several years, but is inclined to believe that very few, if any, of the members of this Association have a sufficiently accurate knowledge of their costs to enable them to determine readily what they should add to their prices to meet some special requirement in the specifications calling for prolonged steaming, a greater period for maintaining the vacuum, or some other change in the process which does in fact add to the cost.

The purpose of these preliminary remarks is to explain the importance of accurate records of the fuel consumption of the plant, not only for the purpose of reducing the costs, but of enabling the actual cost to be arrived at accurately.

In adopting systems of plant records it is very easy for one to become so enthused that he may saddle himself with so many rules, regulations and records that the benefits are more than offset by the expense of carrying out his ideas, but a little common sense mixed with the proposition will cause him to find some middle ground which will enable him to accomplish his purpose without undue expense or annoyance.

The practical way for an individual plant operator to reach the position of highest efficiency is:

1. To ascertain exactly what results he is getting.
2. After learning what his results are, to correct all those things which appear to need correction.
3. To get the benefit of the experience of his fellow members of the Association.
4. After obtaining all available information from his his associates, to make further improvements in his plant which may be suggested by the information so obtained.

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5. Adopt a system of plant records which will enable him to discover promptly any falling off in the results which may be due to improper handling of his plant.

It would seem that this Association could well afford to employ one or more expert engineers who would make periodical visits to all of the plants belonging to the Association for the purpose of making tests and investigations based upon which improvments in methods may be made.

The first duty of these engineers should be to make careful and accurate tests of each plant as now operated, establishing the existing facts with reference to the efficiency of the boilers, the quantity of steam consumed by the entire plant for 24 hours, the quantity of steam consumed during each step of the process and the quantity of steam consumed by each steam-using machine when operating at its normal and usual rate.

The next step would be to have the engineer make the necessary recommendations for the changes which should be made in the plant to bring it up to the proper standard.

After having done this work at each of the plants in the Association he should proceed to test again all of those plants which had followed his recommendations and make further suggestions if the experience gained by him in other plants will suggest any to him.

After the plant has been put in what he would regard as first-class condition, a careful and accurate test should be made with a complete log describing the details of the operations and re-establishing the steam consumption of the various machines.

This last test can then be regarded as a standard which the plant operators should endeavor to live up to.

The engineer should devise record forms, and these records should be religiously kept up by the operatives of the plant. All records used by the various plants being uniform so that comparisons can be readily made.

When one stops to consider the value of the information which a competent expert would obtain by these numerous tests and investigations it would seem that every plant operator would welcome the proposed plan.

The exact form of these records should be designed by your engineers after acquiring the intimate knowledge which they would gain from their experience, but I would suggest the following as a basis for these records:

A separate log sheet should be provided for each apparatus involved in the consumption of fuel. The sheet should be attached to a board and hung at some convenient point so that the man operating the apparatus can make the proper entries.

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The boiler room log should be written up every hour, and should record the steam pressure, the temperature of the feed water, the temperature of the flue gases, the temperature of the atmosphere; the reading of the boiler-feed-water meter and weight of coal delivered to the boiler room floor.

Preferably the log should begin at the beginning of the day watch so that the results obtained by the two watches can be compared and a spirit of competition between the firemen aroused. The coal supply should be under lock and key and at the beginning of each watch the quantity of coal estimated to be required for that watch should be weighed out and deposited in bunkers convenient to the boiler. If any coal remains in the bunker at the end of the watch it should either be weighed or its weight estimated and credit noted on the log; and if any coal above the estimated required quantity is needed the proper notice of that fact should be taken.

It is characteristic of firemen, as it is of all men, to use sparingly anything the use of which is charged to them and also to endeavor to make an allowance for a certain purpose to fulfil that purpose.

Where boiler experts have guarantees to meet, it is customary for them to deal out to the fireman the quantity of coal in a unit of time which the boiler may be allowed to use and come up to its guarantee. The human peculiarity just named is thereby capitalized.

This method of handling coal does not involve any great amount of trouble nor expense, but even if it does involve some additional expense it will be found that the saving in fuel far more than offsets that expense.

The log of the vacuum pump should show the time the pump is started, the time it stopped, the average revolutions per minute, the temperature of the water supply to the condenser, the temperature of the condenser overflow, and should also show 10-minute readings indicating the degree of vacuum until the vacuum is down to the required point; the purpose being to ascertain how long it requires to lower the pressure.

There should be a log also for the pump supplying water to the condenser, if such a pump is used. This log should show the time started, the time stopped and the average revolutions per minute.

There should be logs also of similar character for the oil pumps and in addition to the information called for above these pumps should give the pressure against which they are operating and there should be a statement telling what character of work the pumps were doing.

Similar records should be kept of the hoisting engines, the cranes, the electric light engines and any other machines using steam; the

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log in each case being written up by the man who operates the machine. At the end of the day these logs should be turned into the office together with the charts from all recording instruments and written up on one sheet upon which the records from the various parts of the plants will also be entered so that the superintendent will have a complete and comprehensive understanding of exactly what took place in his plant for the previous 24 hours.

The proper study of these records would bring to light most valuable information and would enable the plant operator to detect any increase in costs and apply the necessary remedy promptly.

Any plant superintendent who carries out these suggestions is being asked to do no more than is done in every well regulated and successful manufacturing establishment, and if all operators of wood-preserving plants would adopt the systematic methods that have been proven to be absolutely necessary in the large industries of the country, the reductions in the price to the consumer would make the use of treated material much more general and the net profits to the wood-preservers would be even greater than they are at present.

This work, of course, can be greatly simplified by the general use of recording instruments and revolution counters.

It is recommended by the General Committee that:

1. The expansion table for creosote be adopted.
2. The table for determining cubical contents of poles and piles be adopted.

For next year's work, it is recommended:

*a.* In connection with the table for cubical contents of poles and piles, this or some other Committee compile information on tapers.

*b.* That not exceeding three definite subjects be selected from the classification given for next year's work of the Committee.

*c.* That the Committee be larger.

A. L. KUEHN, *Chairman*
GEO. M. HUNT
C. W. LANE
A. M. LOCKETT
FRANK MCARDLE
AUGUST MEYER

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MR. A. L. KUEHN: Mr. Chairman, I move you that the following be adopted as recommended practice: *The standard temperature at which creosote shall be measured is to be 100° F.*

THE PRESIDENT: Is there a second to the motion?

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MR. C. E. GOSLINE: I second the motion.

THE PRESIDENT: You have heard the motion. All those in favor signify by saying "aye"; contrary, "no." The motion is carried.

MR. A. L. KUEHN: Mr. Chairman, I move the adoption as standard the table for expansion of creosote, given on page 242. In making this motion I would like to offer this discussion. This table, you will notice, requires division, and I think that table represents the common practice. It has been suggested that it is a little easier to do multiplication, and that the reciprocals of this table be also given, or given instead of this. I would like to add to that motion that this table, as well as the reciprocal table, which will require multiplication instead of division, be published in the MANUAL OF RECOMMENDED PRACTICE.

THE PRESIDENT: Is there a second?

MR. C. H. EASTWICK: I second the motion.

THE PRESIDENT: All those in favor of the motion say "aye"; opposed "no." The motion is carried.

MR. M. K. TRUMBULL: That raises an important question which might lead to confusion in the use of the table. For instance, the class of men at the plants who ordinarily use these tables might turn to the wrong table and multiply rather than divide. I think the question should be submitted to the Association as to whether, in its opinion, the use of this table should be confined to one or the other basis, either for division or multiplication, and publish but one. I have found in my own experience that we got better results by using the table of reciprocals. I prepared such a table. The men who use it feel more at home with multiplication than long division. This is largely a personal question with the man who is performing the detail work.

MR. A. L. KUEHN: I might say that I realize the importance of Mr. Trumbull's point in publishing two tables. This table has been adopted as a standard by at least one, and I think two other associations, that are making reports on this question. Therefore, if the second will consent, I will withdraw the latter part of my motion and ask that this one be published only. Then you have the information. It is a very simple matter for any concern that believes their men can do better with multiplication to just make up a table of reciprocals. They have then accepted the coefficient of expansion. That is the main feature in this table.

THE PRESIDENT: Are there any objections to accepting Mr. Kuehn's suggestion as he has just now made it? If not, it will be considered that the suggestion has been adopted.

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MR. A. L. KUEHN: I move that the table entitled, Volume of Piles and Poles, as given on page 249 be adopted as recommended practice.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

Are there any further remarks? Are there any motions as to what shall be done with the remainder of the report?

MR. J. H. WATERMAN: Mr. Chairman, if agreeable to the Committee, I move you it be accepted as information.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Any remarks?

MR. J. C. WILLIAMS: Mr. President, just as a matter of cross-reference, I will point out that in Mr. Lockett's part of the paper, on page 250, second paragraph from the bottom, is a paragraph about commercial conditions. I previously made some remarks about that which were published on page 306 in the 1915 PROCEEDINGS. Anyone reading Mr. Lockett's paper might be interested in looking up what I said at that time.

MR. V. H. ROEHRICH: Mr. President, I was interested to note that nothing was said in that report about testing the coal. I found in connection with the work of testing for the city of St. Paul that it is worth while to watch the heat units or B. T. U. of the coal, using a calorimeter.

THE PRESIDENT: Any further remarks? If not, all those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

We will now have the report of Committee No. 1 on Preservatives. I will ask the Secretary to read the names.

SECRETARY ANGIER: Mr. E. B. Fulks, Chairman, Mr. S. F. Acree, Mr. S. R. Church, Mr. C. N. Forrest, Mr. W. H. Fulweiler, Mr. A. L. Kammerer, Mr. A. E. Larkin, Mr. O. C. Steinmayer and Mr. C. M. Taylor.

MR. E. B. FULKS: Mr. President and Members of the Association: You have in your hands the report of the Committee on Preservatives, but before we begin the consideration of it I want to say a little in the direction of calling the attention of the members of the Association individually to some feelings I have in connection with the work of this Committee.

The mere reading of this report will not convey to you any adequate idea of the immense amount of work that really has been done

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by individual members of this Committee. I myself have a very high appreciation of it and a very deep feeling of gratitude toward members of the Committee for the way in which they have worked on this Committee, and for the amount of work they have done, but even beyond that, and, as I consider, of more importance, is the spirit with which this Committee has worked this year. It is a little hard for me to put clearly just how I do feel about it.

Personally, I have had a feeling that the members of this Committee when acting as members of this Committee really have been self-sacrificing, that is, they have approached the work of the Committee as members of this Committee, and not as individuals with axes of their own to grind. I feel that they really have made a conscientious effort to divest themselves of their personal interest in this matter, and that they have tried to work toward the end of preparing a report which would present something constructive, and which would tend toward the advancement of this Association and toward the wood-preserving industry as a whole. I felt that it was due the members of the Committee that this be brought to the attention of the Association, because I felt quite sure they would not appreciate it just from a mere reading of the report.

The individual members have done a great deal of work, detail work of one sort or another, laboratory, office and otherwise, all through the year on this thing, and I believe the Association will agree with me in saying that they have presented a set of specifications for various things which are far in advance of any specifications of a similar nature heretofore presented to this or any other association. These specifications, even though they are not perfect, afford, the Committee feels, a most excellent basis upon which future constructive work and work tending toward perfect specifications can be based, and if these specifications are adopted, future committees will have a starting point which is solid, and something upon which they can work and improve and thus arrive at a point which is highly desirable.

Now, as to the report as a whole. In preparing the report under the instructions of the Executive Committee, the work naturally fell into four classifications, that is, the compiling and bringing together in one convenient form all the specifications bearing on the subject heretofore adopted by this or any other association, the preparation of specifications for coal-tar preservatives; the preparation of specifications for zinc-chloride preservatives; and the presentation of all information available concerning the use of water-gas-tar as a preservative. On this basis the work was divided among four sub-committees, each having one of those subjects in charge.

To begin with the last, the work of Sub-Committee "D" in connection with the water-gas-tar preservative, there is no question but

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that this Committee has presented a great deal of information on this subject, and they have presented this in concrete and detailed form, in a manner which heretofore has never been done. This matter has been discussed, of course, at length for years before, but there has never before been presented a written, detailed description or any compilation of information about this material. This Sub-Committee I know personally has spent an immense amount of time collecting this information. They have presented here a few photographs. As a matter of fact, they presented a very much larger number of photographs than this, but for practical reasons and reasons of expense, the greater portion of them had to be eliminated from the printed report. This Committee did visit any number of streets, I do not know how many, in various cities, and presented what I consider a very valuable piece of information concerning this matter. The Sub-Committee on the compilation of the work heretofore done by other associations, of course required a great deal of work, which was more or less of an office nature, you might say, a compilation nature, but it did require a great deal of time, and they have presented this in a form which will make that information readily available to any of you who in the future may have occasion to use it. The Sub-Committee on Zinc Chloride carried on a great deal of correspondence and investigation, and presented a specification for zinc chloride. In addition to this it had one problem upon which it spent a great deal of time and work, and which unfortunately it has not been able to solve as yet, that is in arriving at a satisfactory method for the sampling of zinc chloride. The Committee has had to leave that for future investigation. There seems to be something in connection with that which is rather difficult to get at.

Now as to the other Committee on Preservatives derived from Coal Tar, this Sub-Committee approached this work with a good deal of hesitancy. Of course, it realizes that this has been the rock upon which the thing has gone to pieces in the past. After a great deal of thought and discussion it decided not to follow the lines heretofore followed by committees in attempting to write these specifications, namely, that of trying to write a single specification which would cover the two general classes of this material, that is the straight distillate oil and the so-called mixed oil, but to write the best specification it could possibly devise for each one of these classes of oils, that is a specification for distillate oil and a specification for mixed oil. Under the instructions of the Executive Committee this Committee on Preservatives was to prepare specifications for these materials, both for ties and timber, and for wood blocks. This necessitated writing these two classes of specifications; in other words, it makes four specifica-

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tions which the Committee is presenting, two for distillate and two for mixed oil; or putting it the other way around, two for ties and timber and two for paving blocks.

The Committee did a great deal of work of an analytical nature, that is I mean of a laboratory nature. It based its work on specifications heretofore adopted by other associations, and on common practice, but it tried to strengthen those specifications in such a way that any person using the specifications presented at this time, desiring to purchase a distillate oil could take this specification and apply it to the material he has bought and be sure that he got the material that he is trying to buy, and the same thing in connection with a mixed oil. If he wants to buy a so-called coal-tar-creosote solution for ties and timber containing 20% of coal tar, he can use this specification, apply all these tests that have been provided, and rest assured that he is getting what he is trying to buy, that is a material which contains approximately 80% of distillate oil. Of course, the Committee does not claim that these specifications will hold that to an exact 80%. It is impossible in the knowledge that the Committee has gained so far to get any test that will hold it down that close, but the Committee holds that these will protect that reasonably. In other words, by the use of these specifications the Committee feels that any buyer using these specifications or any particular one, will be more amply protected than he ever has been by any specifications heretofore used, that the outgrowth of any one of these specifications will ultimately be a specification that will be a thorough protection.

Except again to reiterate my appreciation of the spirit in which the Committee has worked and for the great amount of work it has done, I feel there is nothing further to say. You have the report in your hands. Unfortunately, the Appendix containing the data on which this work is based could not be gotten out in time to be distributed earlier. However, I must say now that this Appendix only contains a very minute part of the work this Committee really did do. The Committee has just selected examples to prove its points, but you must not think for a moment that the work of the Committee is based on these figures entirely. It perhaps had from ten to twenty times this amount of figures which the Committee used itself. There are a number of mistakes of a minor nature in the report, largely typographical, which it is not necessary to bring up, except as occasionally they are essential, and they will be mentioned at the proper time.

The conclusions of the Committee in the printing of this pamphlet, have been divided by some of the other material, that is, the conclusions begin on page 55 and conclude on page 65. That does not mean that there are twelve pages of conclusions, but it means that some ten pages intervene from the printing of the first conclusion to the printing of

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the last. I take it now that it is in order to proceed with the report. The Committee recommends for adoption in the MANUAL certain things, and recommends for adoption as standards and for the MANUAL certain other things by clauses. I take it these will be acted on one at a time.

The first recommendation of the Committee is for insertion in the MANUAL the definition of tar, as presented by Sub-Committee A on page 280. This definition of tar is one adopted by this Association some years ago, and the Sub-Committee finds no reason to offer any changes in it, and recommends it for adoption. I move, Mr. Chairman, the adoption of that clause.

THE PRESIDENT: Any second to the motion?

MR. A. L. KUEHN: I second the motion.

MR. F. D. MATTOS: Mr. President, in regard to the specification on page 280 covering zinc——

THE PRESIDENT: Mr. Mattos, may I ask you as these different recommendations are presented that you confine your discussions to that particular subject? If you want to talk about zinc, that will come a little later on; if you will just wait and make your remarks on that, when that question comes up.

THE DELEGATES: Question, question.

THE PRESIDENT: If there is no discussion, all those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next is a definition of creosote, which takes the same points as the other. It was adopted at the same time. I move the adoption. That is on page 280.

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: You have heard the motion. Any remarks? This motion is on the definition of creosote. All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: No. 3, the Committee recommends for insertion in the MANUAL the method of analysis for zinc chloride as presented by Sub-Committee "A" on page 280. This method of analysis is one adopted by the Association some years ago and has been printed once or twice in the PROCEEDINGS. I move the adoption of that.

MR. A. L. KUEHN: I second the motion.

THE PRESIDENT: Any remarks?

MR. L. C. DREFAHL: Mr. Chairman, there is a slight error in the method as outlined here. I believe the one given here is not

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exactly the method which was outlined in the PROCEEDINGS of 1912. There seems to be only a slight difference, but nevertheless it is not exactly the same as 1912.

MR. E. B. FULKS: You will pardon me, Mr. Drefahl. I wish to say that Mr. Drefahl appeared before the Committee and called attention to this. I forgot it. Evidently this was adopted in 1912 and printed in the PROCEEDINGS, and then was printed in 1913 or 1915 or some other time, and in the reprint it was not printed exactly as the previous times, and this one has been copied from the reprint which accounts for the error. I have forgotten what the error is. Mr. Drefahl called that to the attention of the Sub-Committee, and it agreed to take charge of the matter. The one finally printed will be the one that was printed and adopted in 1913. Am I correct in that, Mr. Drefahl?

MR. L. C. DREFAHL: 1912.

THE PRESIDENT: Any further remarks on the adoption of this method of analysis of zinc chloride?

THE MEMBERS: Question, question.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: That includes all the material that has heretofore been adopted by the Association, which the Sub-Committee feels justified in recommending for insertion in the MANUAL. At one time previously the Association did adopt a standard thermometer for coal-tar creosote distillations. It so happens that various other associations have adopted thermometers for essentially the same purpose, but there have been slight differences in the description of each one of these, which are minute and do not affect the general results, but there are differences, and they have resulted in the manufacturers having to make four kinds of these thermometers for the one purpose. Representatives of this Committee have met with representatives of other committees, and have come to an agreement to use the same standard for this thermometer. This standard will come up later on simply as a part of the method of making creosote analysis. At this point the Sub-Committee "A" recommends that the specification for standard thermometer heretofore adopted be repealed. The specification is presented by Sub-Committee "A" on page 282. I move the recommendation of the Sub-Committee be adopted and the standard theremometer be repealed.

MR. A. L. KAMMERER: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

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MR. E. B. FULKS: That concludes all the recommendations concerning that part. The Committee now recommends for adoption as standards and for insertion in the MANUAL the following: Zinc chloride as proposed by Sub-Committee "C" on page 326. I move the adoption of this.

MR. A. L. KAMMERER: I second the motion.

MR. F. D. MATTOS: It seems to me that unless we specify a minimum percentage in this matter of zinc chloride, that we will be lowering our standards and letting down the bars and by so doing encourage the production of a very poor quality of zinc chloride. I feel that it is absolutely essential to place a limit on this matter and unless we do, our companies may be obliged to pay transportation charges on a lot of impurities which have no preservative value and the presence of which may be objectionable. This matter should be freely discussed.

MR. J. H. WATERMAN: Mr. President, our specifications which Mr. Angier had more to do with probably than any other one, read "not less than 94% soluble chloride of zinc." Now I would like to have Mr. Angier explain to these people what he thinks of this recommendation, and I would like to have the Committee explain to us why it changed it.

MR. E. B. FULKS: Pardon me. My understanding of this is that the Committee has not made any change in regard to that point. It has simply taken the specification previously adopted by the American Railway Engineering Association and has made some slight changes, namely, about the iron, and introduced something about its being bought on the basis of 100%, but my understanding is that there never has been any such requirement for a minimum content of zinc chloride in any specification adopted by an association. It is true those things exist in some contracts.

MR. F. J. ANGIER: Mr. President, with reference to the specification Mr. Waterman refers to, we have also on the Baltimore & Ohio the same specification that he has on the Burlington. That gives a limit of soluble zinc chloride of 94%. It seems to me there should be a limit set. Otherwise, as Mr. Mattos has said, they can have 75% soluble zinc chloride, or any other amount. There is another point I might mention, and that is the iron content. We state in our specifications that it may be a trace, or 0.022. When we made our last contract for zinc chloride I took the matter up with the company to see if it would make a reduction in price if we changed that to read 0.25, and the company replied that it would make no change, that it would cost just as much. I believe 0.25 is the amount specified by the American Railway Engineering Association. Our Committee now has doubled

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that and made it 0.50. I do not know what effect that will have on the treatment of timber, but if it will bring about a reduction in the price of zinc, and has no injurious effect on timber, I think it is a pretty good thing.

MR. E. B. FULKS: Mr. Chairman, if I may suggest, Mr. Taylor has considered all these points, and I think can clarify the situation a little. Mr. Taylor, will you make a statement about this?

MR. C. M. TAYLOR: In reference to the proposition of limiting the available zinc chloride to 94% it is true that it has appeared in most contracts up to date, and it seems reasonable and rational that there should be a limit to the per cent. of available zinc chloride in any fused salt of zinc chloride. The impurities of zinc chloride are some basic zinc chloride, which is not available for preservative purposes, some water and such other salts as ammonium chloride and magnesium chloride, which, to our minds at present, have no bad effect on the zinc chloride. The question of limiting it to 94% is proposed by one of the large producers, and it has made quite a point of it to the Committee.

As a member of the Sub-Committee, I do not feel that we have given all the producers a chance to be heard on the subject, and in view of the fact that we in our report are not specifying any minimum limit, it leaves the question open for discussion both by consumers and by the producers, so that if next year, we do want to put a limit of 90 or 94 or some other percentage, the producers and consumers can produce some reasons for placing such a limit. We do not know what is going to take place in the zinc market, and I think that the contracts already placed by the members of the Association, specifying 94% available, will protect them for the ensuing year.

In the meanwhile, I would suggest that the producers submit to the Committee on Preservatives some reasons why the percentage should be 94% other than that the last 15 years it has been 94%, and it has become a habit. I strongly recommend on the part of the Committee that the specifications as given in this report be adopted this year. It is in line with good practice, but if some economic reason should arise during the ensuing year requiring that the limit shall be made 94%, let them produce the facts.

MR. A. E. LARKIN: Mr. President, the specification that has governed the manufacture and distribution of zinc chloride in the fused state for a number of years has made 94% the low limit of purity.

It has been explained to the Committee that 2% of impurities will creep into this material and that there is usually 2% of water that cannot be avoided. This accounts for 98% of the material furnished.

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Manufacturers agree to account for 98% of the product furnished, 94% of which is to be pure zinc chloride. To lower the standard would simply invite adulteration of the material and this certainly should be against the principles of the American Wood-Preservers' Association. Is it any more difficult to furnish fused zinc chloride 94% pure now than it has been years prior to this time?

MR. J. H. WATERMAN: I say from a common sense standpoint when this convention adopts something as standard and this Committee, or the Chairman of the Committee, admits when he introduces the Committee to the convention that they do not know how to sample it, that we ought to at least refer it back to the Committee for another year. Mr. Taylor, who spoke in favor of this, says that the contracts are all made for a year, so we cannot hurt anybody. Why do we want to put something in the MANUAL if we cannot tell the fellow who gets it or receives it how he is going to sample it? From my standpoint, I say the common sense standpoint, not a technical standpoint, it is absurd. Therefore, I move to amend the motion. Is there a motion before the house?

THE PRESIDENT: There is.

MR. J. H. WATERMAN: That we refer this back to the Committee until it can tell us how to sample zinc chloride.

MR. A. E. LARKIN: I second the motion.

THE PRESIDENT: Gentlemen, the amendment is out of order in view of the fact that it is contrary to the motion.

MR. J. H. WATERMAN: I move to substitute my motion instead of the original.

THE PRESIDENT: Is there a second to that?

MR. A. E. LARKIN: I second the motion.

MR. E. B. FULKS: Mr. Chairman, I would like to say a few words. This whole situation was precipitated rather abruptly in the meeting yesterday of the Committee. The Sub-Committee had presented this specification which it had drafted as the result of its information. Yesterday representatives of manufacturers appeared before the Committee with these suggestions concerning this specification. The Sub-Committee felt that perhaps those suggestions were quite proper and correct. It does not question those at all, but they came so suddenly it had no time to investigate them and since they only came from one source, the Committee felt a bit of hesitancy about coming right in and proposing them as a specification. It felt that the specification, as it had proposed it, is at least as good as any specification now a standard of any other association, and that it does not

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preclude anybody when they want to buy zinc chloride from putting in some clause relating to minimum content of zinc chloride. But any clause relating to the minimum content of zinc chloride necessarily, of course, involves a method of sampling which, as I said before, there seems to be something exceedingly difficult about making.

The Committee had up personally and by correspondence with all the manufacturers of zinc chloride this question of how they were going to sample the drums. The manufacturers could give them no light on the subject and they could not arrive at anything themselves, so if the manufacturers do not know how to sample it and the Committee does not know how, why certainly it is something that has got to be worked out. That is only a side light, so far as this particular phase is concerned about this minimum content. It is perfectly obvious that is a reasonable thing and should be included in the specification, but the Sub-Committee feels that it is not justified in setting that minimum right now with the information it has. Personally, I would hate to see the whole thing thrown back for further work, just on that account. I think it would be much better if the specification proposed, although slightly imperfect, be adopted as the standard at the present, and later, at the proper time, it can be referred to the future committee for investigation and correction. I think it would be a mistake to throw the whole thing out as it stands.

MR. S. R. CHURCH: Heretofore there has been no satisfactory device for sampling tank cars of creosote oil for the purpose of determining the percentage of water in the oil. For the past two years I have served on a special committee to design a sampler for that purpose. The work has just been completed. I mention this now in order to point out the fact that the lack of a suitable sampling apparatus has not stopped people from putting a clause in every contract, limiting the percentage of water allowed in the oil. They did not refrain from writing specifications merely because there was no perfectly satisfactory method of sampling.

MR. A. E. LARKIN: Mr. Chairman, it is apparent from the remarks just made by the chairman of this Committee, Mr. Fulks, that we are not ready to adopt the specifications submitted by this Committee as a standard. The only argument Mr. Fulks has made why we should accept and approve this specification is that it is a step in the right direction and that to adopt this standard now for publication in the MANUAL would save considerable delay. The fact that he admits there is a doubt in the minds of the Committee about the matter is the very reason why it is a mistake to adopt any standard at this time. His statement is proof conclusive that the matter has not been considered carefully enough to warrant even the members of this Committee

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in recommending the adoption of this specification as it stands, for publication in the MANUAL.

MR. C. M. TAYLOR: Mr. Chairman, the report as submitted by the Committee is fit and ready to go into the MANUAL. We can at any time amend or add to that specification. I am almost certain there will not be any change by any subsequent convention of the part that is now ready for the MANUAL. There probably will be put in at some future time a minimum limit of available zinc chloride. We started out first with a fractionation of creosote oil and have gradually improved the analysis of creosote oil. That has not altered at all the original specifications. The same thing exists in connection with zinc chloride. This basic clause, we would like to have that adopted as proper, and if the manufacturers can prove to us that later we should have a minimum, and, as Mr. Waterman says, it is common sense that we should have a minimum, let us prove that that minimum protects us and does not increase the cost. It is very possible that the refining of zinc chloride from 90 to 94% increases the cost. There have been quantities of zinc chloride on the market which ran between 90 and 94%.

MR. J. H. WATERMAN: From 85 to 90%.

MR. C. M. TAYLOR: Let us not do it this year. Let us make them prove it. They have only come forward so far and said we want 94. The part that is now before the convention is the basis for zinc-chloride specifications. If we want to revise afterwards and put a minimum on, all right.

MR. J. H. WATERMAN: Mr. Chairman, everybody that has spoken on this subject admits that we ought to have a minimum, and I hope this convention will support my motion.

MR. A. L. KAMMERER: I want to call the attention of the Association to the fact that the essential part of this specification is that it specifies that the material shall be furnished on the basis of the actual 100% zinc chloride present, which I think is establishing a great deal, and it is not lowering the standards. That is the essential feature of these specifications as submitted, and the question of what the minimum amount shall be is secondary to that and can be established when there is more data at hand. This question was not considered by the Sub-Committee, because of the fact it was not brought up until yesterday afternoon, and the Sub-Committee hardly felt that it could at the last minute fix an arbitrary figure of 94% when possibly 92% or 90% might be considerably cheaper; in fact, out of all proportions to the advantage of the small percentage gained in purity. For that reason the Sub-Committee has been unwilling to decide on any arbitrary figure of purity. As I said before, the essential part of the specification is that the zinc chloride shall be furnished on the basis of the percentage of pure zinc chloride present.

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As far as establishing any method of sampling, the Committee felt that there was considerable difference of opinion on that, and in lieu of being able to come to any definite conclusion as to a standard, that would have to be left to the individual buyer, or his chemist as to how he would sample that material. I think the Association would make a great mistake if it did not adopt this specification as a starting point.

MR. GEO. E. REX: For the information of the Association I would like to ask Mr. Drefahl if we wait until we can recommend a satisfactory sampling method of fused zinc before we adopt a zinc-chloride specification how long will it be before we have a specification?

MR. L. C. DREFAHL: I did not quite understand you, Mr. Rex.

MR. GEO. E. REX: If we wait to adopt a specification of zinc chloride until the Association has a satisfactory method of sampling, how long will it be before we have a specification for zinc chloride?

MR. L. C. DREFAHL: That would be rather hard to say, Mr. Rex, but I do not think the question of sampling is an insurmountable question. I think if the manufacturers and the consumers got together on that point in a reasonably short period of time, there should be some solution to that particular problem, after which it is only a question of a short period of time before a specification could be arrived at using the sampling method as a basis. I do not think there are any difficulties connected up with it at all.

MR. GEO. E. REX: You do not think there is any difficulty connected with sampling?

MR. L. C. DREFAHL: The sampling is a difficult matter. It has to be done a certain way. It is going to take some outlay at the manufacturers' plants. Whether or not all the small plants would be able to prepare for it and make the necessary preparation on account of the cost, is a matter that would have to be investigated.

MR. GEO. E. REX: We have been using zinc chloride for a good many years, and so far as I know nobody has ever presented any satisfactory method of sampling it. My feeling is if we wait for that method of sampling, until that method is perfected, before we adopt a zinc-chloride specification, there will be several more gray hairs on our heads before we get that specification for zinc chloride. I feel that this portion of the Committee's report is all right and should be adopted (applause).

MR. A. E. LARKIN: Mr. Chairman, I think it would be very easy for Mr. Kammerer's remarks to be misunderstood. He explained that the vital point in this question is not the amount of zinc in the chloride salt but the purity of the salt itself. This would imply that if the zinc were pure but amounted to only 75% of the contents of the

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drum it would be acceptable to the purchaser. If we were to receive drums of chloride of zinc which contained only 75% of the pure zinc chloride and 25% of adulteration, we should have great difficulty in using it. I am sure, for instance, that none of the railroad operators would allow treating to proceed with 25% of adulteration or impurities in the solution. With the specification standing as it does now, with no minimum, we are just as liable to get 75% chloride of zinc as we are 94%, necessitating adjustments on freight, extra handling, etc. This specification is certainly not ready for adoption.

MR. WALTER BUEHLER: Mr. President, as Mr. Kammerer has stated, there are basic principles recommended by this Committee that are of more importance than the question under discussion. It seems to me the question under discussion is something that lies between the purchaser and the seller. I believe that this Association should endorse the recommendation of the Committee.

DR. H. VON SCHRENK: I simply want to say a word in commendation of the specification. I think a good many of the objections raised to the specifications are more or less irrelevant. The basic principles involved in this specification are fundamental. I do not think anybody will question that. I do not see personally any reason why this Association should not endorse a distinct advance in the art of writing specifications simply because there are certain factors that have not yet been developed sufficiently to make it possible to adopt it as a whole.

Referring to some of the remarks made here as to the small impurity, as stated by one of the speakers, the small percentage of magnesium salt or ammonium salt will not bother particularly. There are a great many cases where it has been used with a very much higher percentage of impurity than any we have here. I personally feel very strongly there ought to be some limit, and I think everybody else does. We have here in this specification for the first time a fundamental statement of facts, and there is nothing wrong in the specification. Why should this Association throw it out simply because it is not absolutely perfect? As Mr. Rex says, if we wait until we get all these factors we may have to wait a long time. I would very strongly urge the Association to adopt the specification.

MR. A. E. LARKIN: Mr. President——

THE PRESIDENT: Just a moment, Mr. Larkin, please. It is regrettable that our time for our meeting is limited. We will have to divide our time as well as we can. I feel that our time for this particular discussion is up. We will allow a few minutes, however, for any remarks that are particularly pertinent to this subject before putting the question. We will give a few moments to the discussion.

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MR. A. E. LARKIN: Mr. President, if we adopt this specification as it stands it is a plain invitation for some one to start up in the zinc-chloride business who is not capable of developing a 94% pure product, but might be able to manufacture something 75% pure. If we eliminate the minimum required and let the bars down, we will not have the opportunity to work with the high-grade material we are now getting.

MR. L. B. MOSES: Mr. President, I see no reason at all why Mr. Waterman's position should not be carried out just as well after the adoption of this Committee's report as before it. If the Committee's report is adopted with instructions to the Committee on Preservatives to proceed along the lines Mr. Drefahl has suggested and bring in next year, if possible, a method of sampling, we will not have gone backward and we can go right ahead, forward, and just because he is a good fellow I am going to ask him to withdraw his substitute.

MR. J. H. WATERMAN: All right.

MR. E. B. FULKS: Gentlemen, I am glad to hear that the one point I had in mind is the point agreed on. When I started the discussion on this report the idea was that we were trying to establish a starting point. If we adopt this thing we have got a starting point. If we do not we are in the air the same as we always have been. I am awfully glad he has withdrawn his substitute.

MR. J. H. WATERMAN: My friend referred to me as a good fellow. I want to be. I want to endorse this Committee and its work. However, I cannot see their point. They all argue that they are not even sure, the President, Mr. Taylor and everybody else. Now, I have no objection to accepting this, but I have an objection to putting it in the MANUAL. I have no objection to it being printed in the PROCEEDINGS, none whatever, but I object to its being put in the MANUAL, and that is my substitute motion.

THE PRESIDENT: Gentlemen, there are two motions before the house. One is that we adopt as recommended practice this specification for zinc chloride. There is also a substitute motion that we refer the specification back to the Committee. If the substitute carries, that ends the matter. If it is voted down then we will vote on the original motion. I will now put the substitute. All those in favor signify it by saying "aye"; opposed, signify it by saying "no." The substitute is lost.

I will now put the original motion, which is that we adopt this specification as recommended practice. All those in favor signify it by saying "aye"; opposed, "no." There is no doubt that it is carried.

MR. E. B. FULKS: Mr. President, the next recommendation of the Committee is for adoption as standard and insertion in the MANUAL;

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The specification for creosote for ties and structural timber as proposed by Sub-Committee "B." I move the adoption of this recommendation.

MR. A. L. KAMMERER: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"——

MR. A. E. LARKIN: Mr. President, referring to the recommendation by the Committee, this recommendation for creosote oil for ties and structural timber is a step in the right direction and should be adopted. The Committee, however, does not go far enough. It should answer the question as to what the American Wood-Preservers' Association recommends as the best practice with reference to the right kind of oil to be used for certain work.

The specification that has been most frequently quoted and referred to is the American Railway Engineering Association No. 1 specification for creosote oil, which the members of that Association recommend as the best oil for this class of work. Why should we not at the same time we submit this specification state that it is the one recommended for use by the Association as being the oil that will give the best results in the treatment of timber, piling and ties?

The Committee has submitted a creosote oil for ties and structural timber and a creosote-coal-tar solution for ties and structural timber with no recommendation as to which is the better oil. The Committee has made no qualification in the use of the two materials, and they are apparently on a parity with each other; that is, they might be so considered by the layman or the engineer not having had much experience in the treatment of wood with preservatives.

THE PRESIDENT: Gentlemen, I think all realize that we have a pretty big problem before us. It is one that is far reaching and if we get out on the branches I am quite sure we will not have time to take action upon everything that might come up here at this meeting. The Executive Committee gave certain instructions to this Committee, and it has prepared its report in accordance with these instructions. I think we will have to bar out at this time all discussion or presentation of new matter which does not bear directly upon this Committee's report, and which covers subjects which were not requested from this Committee by the Executive Committee.

As I recall the instructions of the Executive Committee we asked this Committee to prepare specifications for preservatives that are now in common use for treating different materials such as paving blocks, ties and structural timber, but did not ask for any recommendations as to the comparative value of these different preservatives. Therefore, a comparison of values is not a part of this report, and we will not take it up for consideration at this time.

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MR. WM. A. FISHER: If it is in order, Mr. President, I move as an amendment to the motion before the house that the Committee be instructed to present next year additional oil specifications similar to the existing A. R. E. A. specification for Grades 2 and 3.

THE PRESIDENT: Mr. Fisher, in order that we may keep clearly in mind the subjects under discussion I will ask you not to present any paper or discussion at this time which does not bear directly upon the specifications which are now under discussion. After this report has been disposed of, if you then wish to suggest that the Committee be instructed to do certain work next year, it will then be in order.

MR. WM. A. FISHER: If I have an opportunity for that?

THE PRESIDENT: You will have an opportunity for that a little later, if you will allow me to leave your motion until that time comes.

MR. WM. A. FISHER: I will withdraw my motion.

MR. E. B. FULKS: Just a remark, and to prevent it coming up again, I want to say, as indicated by this footnote, the Committee did not intentionally ignore those other two specifications that the American Railway Engineering Association has, and did not consider that they were withholding any of that at all, but it is only humanly possible to do a certain amount of work, and the Committee did all that it could, and felt that in arriving at this specification it has got, it did all the work it could. The Committee really did not have time to consider all those other things with the detail it would want to consider them. Therefore, the Committee considered by making this reference that is in this footnote, to the fact that it presented this type specification, that anyone desiring to make a contract based on lower limits, could easily adjust this specification to meet that circumstance. Of course, the Committee has in mind that in the future that situation will be met, but I just want to say that it was not ignored or left out intentionally, or anything of that sort.

MR. M. K. TRUMBULL: Mr. President, we are discussing the specification on page 307?

THE PRESIDENT: Yes, the specification that has been recommended for a distillate oil for treating ties and timber. If you will confine your remarks to the specification, you will be in order.

MR. M. K. TRUMBULL: Has the Committee any objection to insert in lieu of the symbol, when stating what the specific gravity shall be, the words "compared with water at"? This suggestion is in the interest of laymen.

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MR. E. B. FULKS: The Committee appreciates that point, and has no objection to that. It is very willing to make such corrections as that.

MR. A. E. LARKIN: Mr. President, it is true we are considering the adoption of certain specifications, but I take exception to your statement to the Association to the effect that we must confine ourselves to the instructions given by the Executive Committee to this Committee in the consideration of the adoption of standards, and that the Executive Committee instructions do not happen to provide for the placing of the specifications according to their relative merits. My request should be considered, because you cannot differentiate between the recommendations regarding a specification and the recommendation regarding its use, or at least its proper place relative to its importance as a preservative.

DR. H. VON SCHRENK: I rise to a point of order.

THE PRESIDENT: State your point.

DR. H. VON SCHRENK: This organization in the past has suffered greatly from a great deal of wasted time and energy in discussing problems before the Association. If there is any question as to the ruling the President made, I suggest that an appeal be taken sustaining the President's ruling.

THE PRESIDENT: Gentlemen, I assure you that I do not want to take any arbitrary stand on anything, but the ruling I made was, in my judgment, for the best interests of the Association, and made with the idea that our work may not be obstructed, but that we might be able to accomplish the most during this session that would be in the best interests of our Association. After this report has been disposed of, if the Association wishes to take some time for the discussion of other things which have been suggested by this Committee's report you will then have an opportunity to present such motions or suggestions as you like, and time will be given for their consideration, but unless I am overruled we will not allow new material to be injected into this Committee's report.

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the question signify by saying "aye"; those opposed, "no." The motion is carried.

MR. E. B. FULKS: Mr. Chairman, the next recommendation of the Committee is No. 3, the adoption as standard and for insertion in the MANUAL of the specification for creosote-coal-tar solution for ties and structural timber, as proposed by Sub-Committee "B" on page 307. Mr. Trumbull, your criticism will apply to all these. I move the adoption.

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MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Any remarks?

THE MEMBERS: Question! Question!

MR. A. E. LARKIN: Mr. President, the criticism on this creosote-coal-tar solution for ties and structural timber is the fact that it is not as definite as it should be. It has apparently been surrounded with as many tests as the Committee knows to protect the final mixture. It occurs to me that the way to absolutely protect the purchaser of creosoted materials, and creosote oil especially, is for the purchaser to know in some way what kind of material, what kind of creosote and what kind of tar enters into the mixture. In the interest of clearness a specification for not only the resulting mixture, but a specification for the creosote oil and a specification for the tar should be submitted.

THE PRESIDENT: Any further remarks?

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; those opposed, "no." The motion is carried.

MR. E. B. FULKS: Mr. President, the next recommendation is No. 4. The Committee recommends for adoption as standard and insertion in the MANUAL specification for coal-tar oil for paving blocks, as proposed by Sub-Committee "B" on page 308. I move the adoption of the specification.

MR. A. L. KUEHN: I second the motion.

MR. A. E. LARKIN: Mr. Chairman, I do not like to burden you, but I want to get before you the criticism that I really think should be taken into consideration. Here again I have the same criticism with reference to this coal-tar oil for paving blocks. I think there is no doubt that the Committee should state the difference between these two materials. I know it is not covered by the instructions of the Executive Committee, but nevertheless it is due the members of the Association, and it is due the industry.

The same criticism, except to a greater degree, applies to the specification of the mixture and of the two materials that enter into it. The Committee says that it is not necessary to specify the creosote and the coal tar that enter into the mixture, and yet it states in this particular specification that there shall be 65% of creosote and 35% of coal tar. Now, that is of course subject to manipulation, and by manipulation I mean perfectly honest manipulation by the manufacturer. He will submit materials that will fill the specification, and he can submit any number of materials. He can use a light creosote and a heavy tar, or a light tar and a heavy creosote, and the purchaser is at sea.

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The latter does not know whether or not he has received 65% of creosote. It is absolutely impossible to determine.

MR. S. R. CHURCH: In reply to the last speaker, I wish to say on behalf of the Committee that the intent of the definition which requires in so many words that the oil shall be at least 65% distillate, was that no one could "honestly manipulate" the specification. We hold that if a manufacturer, under that specification, adds more than 35% of filtered or refined coal-gas or coke-oven tar, he does not put it in honestly. In regard to the statement that low boiling creosote can be mixed with a heavy tar to make a mixture complying with the specification, we deny that. The specification for the finished product controls the distilling range of the distillate oil used. Naturally, the distilling points of the distillate oil itself will be somewhat lower than the distilling range of the finished product.

THE MEMBERS: Question! Question!

THE PRESIDENT: Are you ready for the question? All those in favor of the motion please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next is No. 5. The Committee recommends for adoption as standard and insertion in the MANUAL the specification for distillate oil for paving blocks as proposed by Sub-Committee "B" on page 308. I move the adoption of this recommendation.

THE PRESIDENT: Is there a second?

MR. H. S. LOUD: I second the motion.

MR. A. E. LARKIN: Mr. President, referring to the distillate oil for paving blocks, this specification is a step in the right direction. However, this Association should recognize the higher-boiling oils and the heavier-gravity pure-distillate oils should have very careful consideration. The Committee has been asked to recommend a heavier high-boiling oil than is covered by its specification, but it has not done so.

There are many references showing that the high-boiling oils are desirable and most effective, that they should be used, and have given the very best results on record. Read the following from "Lunge," page 355:

> But the successful timber is always found to contain the heavier and less-volatile portion of the oil, the greater bulk of which is composed of substances distilling over 300° C.

These high-boiling oils should be included in the MANUAL as the highest standard available and toward which we should work. It is essential to have high standards. Dr. von Schrenk has made a number of references to high standards, which should be maintained. One example is found on page 202 of the 1912 PROCEEDINGS of the American Wood-Preservers' Association, which reads:

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> We must have a high standard toward which we can work. We get millions of gallons of creosote every year which does fill that specification. That there is oil which is available, which does not do so, is no reason for abandoning the standard. In view of perfectly incontrovertible facts as to the rate with which the poorer oils leave creosoted timber, . . . . . the high standard is the only safe course.

He was referring to the American Railway Engineering Association Grade 1 oil.

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion will signify it by saying "aye"; contrary, "no." The motion is carried.

MR. C. H. TEESDALE: Mr. President, when the American Railway Engineering Association adopted the specification for the creosote-tar solution for ties and structural timber——

THE PRESIDENT: Is it on these specifications that you are talking?

MR. C. H. TEESDALE: Yes, sir. They adopted and placed in their Manual a paragraph qualifying the creosote and tar solution, and I would like to move that this paragraph, which reads as follows, be included in our MANUAL at the proper place:

> This specification is submitted for the guidance of those desiring to use the coal tar addition to creosote for ties only, which practice is firmly established and widely followed. The creosote-coal tar solution is not recommended as equal to creosote in preservative quality, and should be used for ties only when the available supply of creosote is inadequate.

THE PRESIDENT: Mr. Teesdale, that has to do again, as I understand it, with value or relative values.

MR. C. H. TEESDALE: Yes, sir.

THE PRESIDENT: That question is not before the house at this time.

MR. C. H. TEESDALE: Can that be taken up at the proper time?

THE PRESIDENT: After this Committee has presented its report, if we have time to go into the value of these oils, and it is the desire of the Association to go into the value of these oils, that can be taken up.

MR. E. B. FULKS: That concludes the recommended specifications, but the Committee now recommends a number of methods of analysis. Before we start these, there are a number of errors in the printing of these, and so on, which Mr. Church will call your attention to before we start. They apply throughout the whole thing.

MR. S. R. CHURCH: I will not call attention to minor typographical errors at present. Attention should, however, be called to the fact that the drawings of apparatus form an essential part of the

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standard methods. There were a number of pieces of apparatus referred to in the report of Sub-Committee "B," which were also referred to in the report of Sub-Committee "A." In order to save expense, the Secretary quite properly omitted the duplication of these drawings. Unfortunately, we did not make the matter perfectly clear, or the drawings would have been omitted from the reference methods and included in the standard methods, whereas in some cases the reverse of this was done. This will, no doubt, be corrected in the PROCEEDINGS. In looking for an illustration of apparatus referred to in any one of the standard methods, if it does not appear in the proper place, it can be found under the same figure number in the report of Sub-Committee "A."

Just a word in reference to these methods of analysis. They are all part of the general endeavor toward standardization of methods in our own Association and other associations. The distilling test for creosote oil was first standardized by the American Railway Engineering Association. The method was enlarged and refined in details by the American Society for Testing Materials, and now has been taken into our standards. None of the methods are new, excepting the coke test, which is taken from the report of the National Electric Light Association of 1911, and the consistency test of the residue.

MR. E. B. FULKS: Gentlemen, the balance of this has to do with the adoption of methods of analysis. The Committee recommends a number of methods. The first one is a method for the determination of the amount of water as proposed by Sub-Committee "B" on page 309. I move the adoption of this recommendation.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next method presented here is with reference to the determination of the amount of insoluble in benzol, as proposed by Sub-Committee "B" on page 310. This relates to so-called free carbon in oil. I move the adoption of this recommendation.

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next relates to the method for the determination of specific gravity as proposed by Sub-Committee "B" on page 312. I move the adoption of this recommendation.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried.

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MR. E. B. FULKS: The next relates to the Distillation Test as proposed by Sub-Committee "B" on page 313. The Committee recommends the adoption of the distillation test as here proposed. This test includes the adoption of the standard thermometer, which I spoke of a while ago. I move the adoption of this recommendation.

MR. E. W. BRIGHT: I second the motion.

THE PRESIDENT: All those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: Next the Committee recommends the determination of the specific gravity of fractions, as proposed by Sub-Committee "B" on page 312. I move the adoption of this recommendation.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: All those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The Committee recommends the adoption of the float-test, as proposed by Sub-Committee "B" on page 318. I move the adoption of this recommendation.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The Committee recommends the method for the determination of the coke residue as proposed by Sub-Committee "B" on page 320. I move the adoption of this recommendation.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. S. R. CHURCH: Mr. Chairman, it seems proper to state at this point that the Secretary had a communication from the Director of the Forest Products Laboratory, enclosing a paper by Mr. Bateman, commenting on the oil specifications proposed by a joint committee of several societies interested, referring to the conference meeting in Brooklyn last September, and it was said this paper would be of especial interest.

MR. S. R. CHURCH: There is no especial reason why this paper, which is somewhat lengthy, should be read at the present time. A part of this was presented to the Committee by Mr. Bateman and considered by the Committee in its deliberations, and it was of considerable assistance. If the completed work had been received in time, undoubtedly we should have used some of these data in our appendix. As

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Mr. Weiss says in his letter, it substantiates the work of the Committee in general, and there are some suggestions made that may be helpful to the Committee in its future work, and the whole matter will undoubtedly appear in the PROCEEDINGS.

There is also a letter from Mr. E. R. Dutton, Assistant Engineer of Minneapolis, commenting on the coal-tar paving-oil specification. This letter was written by Mr. Dutton before he had been advised by our Committee of the slight change in the specific gravity of the fractions, which was made subsequent to the adoption of the specification, by the American Society of Municipal Improvements. Mr. Dutton, however, by this time, as well as the other committee of the Civil Engineers, has been officially notified of this change.

## REPORT OF COMMITTEE ON PRESERVATIVES.

*To the Members of the American Wood-Preservers' Association:*

Committee No. 1 on Preservatives presents herewith a report of its activities for 1916, and its recommendations to the Association.

The appointment of this Committee was not announced until April 4, 1916, and its complete personnel was not definitely known until April 22. Thus the Committee was very late in getting its work started and, as a consequence, it has not been able to complete its work and the report thereof in as much detail and at so early a date as it had desired.

The instructions of the Executive Committee for the work of this Committee were received by the Chairman on April 17, and a meeting of the Committee was arranged for the earliest date possible, May 15. At this meeting, which was attended by the entire membership, the work to be done was discussed in detail and was apportioned among four sub-committees, as follows:

| | |
|---|---|
| SUB-COMMITTEE A: | S. F. Acree, Chairman<br>O. C. Steinmayer |
| SUB-COMMITTEE B: | S. R. Church, Chairman<br>A. E. Larkin<br>A. L. Kammerer |
| SUB-COMMITTEE C: | A. L. Kammerer, Chairman<br>C. M. Taylor<br>S. F. Acree |
| SUB-COMMITTEE D: | W. H. Fulweiler, Chairman<br>C. N. Forrest |

These sub-committees did a great deal of work during the summer, by means of correspondence and of meetings, and their various reports are made a part of this report in their entirety.

Another meeting of the Committee was held in Cleveland on Nov. 14, at which all the members were present, except Mr. Larkin and Mr. Steinmayer. (Mr. Forrest was represented by J. C. Williams.)

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The chairmen of the various sub-committees presented their reports, which were discussed in detail, and, after a few minor changes, were unanimously approved.

In addition, there was a verbal report from the joint committee, representing this and other associations, for the purpose of developing a standard method for sampling creosote in tank cars. This report was to the effect that the Committee has developed some of the instruments which seemed most promising in its work last year. Several of these samplers have been distributed among treating plants where they are being used under the observation of the Committee. It was thought best to make these tests in winter as well as summer, consequently a report cannot be made until next year.

The reports of the sub-committees, as adopted by the full Committee follow:

## REPORT OF SUB-COMMITTEE A.

Your Sub-Committee was assigned the following:

1. Collect and compile all specifications and definitions concerning preservatives which had been approved by the Association. Recommend such revision as may be necessary, and present for insertion in the MANUAL.

2. Present for information:

   *a.* Specifications for preservatives which have been adopted by other associations or organizations.

   *b.* Methods of tests and analyses which have been adopted by other associations or organizations, or which may be in large use commercially.

Your Sub-Committee has taken upon itself to amplify the first instruction to include methods of analyses and tests which have been adopted by the Association. It finds that Committee No. 1, 1914, has already accomplished practically the entire work, which was printed in the PROCEEDINGS for 1915. However, the findings of that Committee have been verified by a careful search by this Sub-Committee through all the PROCEEDINGS of the Association. Under item 1 it finds (1) that this Association has no standard specifications for preservatives of any kind. Several such specifications have been presented to the Association, but none has been formally adopted; (2) the following definitions have been approved by the Association, and the Committee sees no reason for change. It, therefore, recommends them for inclusion in the MANUAL.

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**Tar.**

*Tar, in the scientific sense, may be properly defined as a non-aqueous liquid product obtained in the destructive distillation of complex organic matter. Tars vary greatly in character, both chemically and physically. They may be roughly divided into three classes:*

CLASS A. *Tars consisting principally of compounds belonging to the aromatic series, and containing well-defined amounts of phenoloids.*

CLASS B. *Tars consisting principally of compounds belonging to the aromatic series, but lacking phenoloids.*

CLASS C. *Tars consisting principally of compounds belonging to the aliphatic series.*

**Creosote.**

*Creosote, in the scientific sense, may be properly defined as any and all distillate oils boiling between 200° and 400° C., which are obtained by distillation from tars consisting principally of compounds belonging to the aromatic series, and containing well-defined amounts of phenoloids.*

3. The following method of analysis for zinc chloride was adopted by the Association in 1912. The Committee sees no reason to change this and, therefore, presents it for insertion in the MANUAL.

## METHOD OF ANALYSIS OF ZINC CHLORIDE.

**Insoluble (Basic Zinc Chloride).**

*Ten to 14 grams of the sample (fused or granulated), or an equivalent quantity of solution, are weighed from stoppered weighing bottles into a 600 c.c. Jena beaker. Four hundred cubic centimeters of cold water are added and stirred until the material is completely in solution. The basic zinc chloride is allowed to settle over night. Solution is filtered through a weighed filter paper (12½ c.m.). Filtrate is received in a graduated calibrated measuring flask, capacity 1000 c.c. The beaker is policemanned, and the insoluble matter on the filter paper is washed thoroughly till the filtrate measures 1 litre. Filter paper containing the insoluble matter is dried over night in a bath heated to 212° F., cooled, and weighed in between clipped watch glasses. Increase in weight is calculated to insoluble (basic) matter.*

*In the line of suggestion, it is necessary to previously wash and dry the 12½ c.m. paper used for filtering the insoluble matter, in order that this paper gets analogous treatment to that used in actual analysis. Owing to the fact that the hydrated oxychloride of zinc is slightly soluble in water, it becomes necessary to make the method empirical, and in order to get concordance between various operators it is necessary to pass all the water necessary to make up the liter through the filter paper upon which the precipitate is retained.*

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**Estimation of Zinc.**

*The filtrate from the insoluble matter referred to previously is made up to the mark and shaken. Three aliquot portions of 100 c.c. each are taken with a 100 c.c. pipette, which has been accurately calibrated volumetrically against the flask used for receiving the filtrate. To each of the aliquot portions in the beaker, 15 grams of ammonium chloride are added and 5 c.c. of strong hydrochloric acid, and diluted to a volume of 350 c.c. with hot water. This is allowed to stand on the steam plate until nearly boiling (180°F.), and then titrated with slow addition and vigorous stirring with potassium ferrocyanide solution, using uranium acetate as an external indicator.*

*This method is not for use where the manganese chloride content exceeds 0.3%. In such cases the method is varied as follows: To the 100 c.c. aliquot portions 1 c.c. of hydrogen peroxide (2½ to 3%) and 10 c.c. of 1 to 1 ammonia are added. Allow this to stand on the steam bath until settled. Filter off the manganese, wash the beaker and paper twice with hot wash water. Dissolve the precipitate in the smallest amount of 1 to 1 hydrochloric acid in the original beaker, and heat until all is dissolved; the volume of the solution should then be about 20 c.c. Reprecipitate the manganese with 1 c.c. hydrogen peroxide and 10 c.c. of ammonia, boil, filter, and wash several times with hot water. Add the filtrate to the filtrate obtained from the first separation. To the combined filtrates add 15 c.c. hydrochloric acid and just neutralize with concentrated ammonia, then add 5 c.c. hydrochloric acid in excess. Add 25 c.c. saturated hydrogen sulphide water to remove any traces of hydrogen peroxide, dilute to 325 c.c., heat to 180° F. and titrate as in the previous case.*

**Estimation of Iron and Alumina.**

*Ten grams of the sample are weighed into a beaker and dissolved in 100 c.c. of water. Dilute hydrochloric acid is added in sufficient quantity to dissolve all the basic zinc chloride. Add bromine water in slight excess and boil off the excess. A weak solution of sodium carbonate is added until a slight permanent precipitate of zinc carbonate is obtained. Add three drops of glacial acetic acid and 2 grams of sodium acetate, and boil. Filter and wash. Redissolve the precipitate in the original beaker with hot 1 to 1 hydrochloric acid. Reprecipitate the iron and alumina with a slight excess of ammonia, filter, and wash free from chloride. Ignite in a platinum crucible, and weigh as* $Fe_2O_3$ *and* $Al_2O_3$.

**Solution Used in Determination of Zinc.**

STANDARD FERROCYANIDE SOLUTION. *Weigh out 43.25 grams of c.p. potassium ferrocyanide and 14 grams of c.p. crystallized sodium sulphite,*

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*dissolve in water, and make up to 1000 c.c. at room temperature. Shake thoroughly. Standardize against a zinc solution of known concentration, prepared from spelter of known zinc content or from c.p. zinc oxide previously ignited. One cubic centimeter of this solution will be equal to approximately 0.01 gram of zinc. Keep the solution in a dark bottle. Shake the bottle thoroughly and standardize the solution each time it is used.*

INDICATOR. *Dissolve 4.4 grams of c.p. uranium acetate (free from sodium) in 100 c.c. of hot water, and add 2 c.c. glacial acetic acid. For a spot test for external indicator work 0.05 c.c. on a paraffine plate gives the most satisfactory results.*

WASH WATER. *In all zinc analyses it will be found sufficient to wash with hot water containing 10 grams of ammonium chloride and 10 c.c. of concentrated ammonia to the liter.*

HYDROGEN PEROXIDE. *This reagent is very perishable. It can be tested for its strength by titrating with potassium permanganate.*

HYDROGEN SULPHIDE SOLUTION. *The usual saturated solution commonly used in the laboratory is employed.*

The Association has not adopted any standard methods of analysis for any other preservative. It has, however, adopted a standard size of thermometer to be used in whatever distillation test is proposed for creosote and other liquid preservatives.

The Committee is advised that Sub-Committee B, in presenting methods of analysis for creosote, will include a specification for a thermometer. This specification is one which a conference of representatives of a number of associations has selected for general adoption, and is not essentially different from the present standard of the Association. The Committee, therefore, recommends the repeal of the present specification which is as follows:

## SPECIFICATION FOR STANDARD THERMOMETER.

The thermometer shall be of glass, well annealed, and shall undergo no serious change at the zero point when heated to 400° C. The space above the mercury column shall be filled with gas, either carbon dioxide or nitrogen, and the thermometer shall have an expansion chamber at the top.

The scale shall read from 0° to 400° C. in 1° C. graduations, which shall be etched on the stem.

The tip of the thermometer shall carry a ring for the purpose of attaching tags. The thermometer shall have the following dimensions:

Total length, 375 m.m.; tolerance, 10 m.m.
Bulb length, 14 m.m.; tolerance, 1 m.m.
Distance from 0 to bottom of bulb, 30 m.m.; tolerance, 4 m.m.
Scale length from 0° to 400° C., 295 m.m.; tolerance, 5 m.m.
Diameter of stem, 7 m.m.; tolerance, 1 m.m.
Diameter of bulb, 6 m.m.; tolerance, 1 m.m.

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When standardized, the accuracy of such standardization should be as follows:

Up to 200° C. to the nearest 0.5° C.
200 to 300° C. to the nearest 1.0° C.
300 to 360° C. to the nearest 1.5° C.

Your Sub-Committee presents for information the following specifications for preservatives which have been adopted by other associations and societies having committees on preservative subjects.

**Zinc Chloride.**

Specification taken from the American Railway Engineering Association's Manual, 1915:

> The zinc chloride used shall be as free from impurities of any kind as is practicable, being slightly basic, free from free acid, and containing not more than 0.25% iron.

No other association has adopted a specification for zinc chloride.

**Preservative Oils.**

Specifications for creosote taken from the A. R. E. A. Manual, 1915:

**Standard Specifications for Creosote Oil.**

> The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal-gas tar or coke-oven tar and shall be free from any tar, including coal-gas tar and coke-oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be at least 1.03. When distilled by the common method; that is, using an 8-oz. retort, asbestos covered, with standard thermometer, bulb ½ in. above the surface of the oil—the creosote, calculated on the basis of dry oil, shall give no distillate below 200° C., not more than 5% below 210° C., not more than 25% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.
>
> (Note: In addition to the above standard specification, the two following grades can be used in cases where the higher grade oil cannot be procured. It should be understood that where it is necessary to purchase grades No. 2 and No. 3 consideration should be given to the use of a greater quantity of creosote oil per cubic foot).

**Specification for No. 2 Grade Creosote Oil.**

> The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal-gas tar or coke-oven tar and shall be free from any tar, including coal-gas tar and coke-oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be at least 1.03. When distilled by the common method, that is, using an 8-oz. retort, asbestos covered,

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with standard thermometer, bulb ½ in. above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall not give more than 8% distillate below 210° C., not more than 35% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

**Specification for No. 3 Grade Creosote Oil.**

The oil shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal-gas tar or coke-oven tar, and shall be free from any tar, including coal-gas tar and coke-oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be at least 1.025. When distilled by the common method, that is, using an 8-oz. retort, asbestos covered, with standard thermometer, bulb ½ in. above the surface of the oil—the creosote, calculated on the basis of dry oil, shall give not more than 10% distillate below 210° C., not more than 40% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

**Specification for Creosote-Coal-Tar Solution.**

This specification is submitted for the guidance of those desiring to use the coal-tar addition to creosote, which practice is firmly established and widely followed. The creosote-coal-tar solution is not recommended as equal to creosote in preservative qualities, and should be used only when the available supply of creosote is inadequate.

1. The oil shall be a pure coal-tar product, consisting only of coal-tar distillates and oils obtained by the filtration of coal-tar. It shall contain no admixture of crude tar.

2. Water shall not exceed 2%.

3. The specific gravity at 38° C. shall not be less than 1.03 nor more than 1.10.

4. Matter insoluble in hot extraction with benzol shall not exceed 2%.

5. The specific viscosity (Engler) at 82.3° C. (180° F.) shall be not more than 1.170 for 200 c.c. No variation above this standard shall be allowed. The term "specific viscosity" in this case shall mean the number of seconds for water at 20° C., given in the official certificate for the viscosimeter used, divided into the number of seconds for the creosote-tar solution at 82.3° C.

6. On distillation by the standard method of the A. R. E. A. it shall yield the following fractions based on dry oil:

Not more than 1% at 170° C.
Not more than 5% at 210° C.
Not more than 30% at 235° C.
The residue at 355° C. shall not exceed 26%.

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**The Use of Coal Tar in Creosote.**

Wherever possible only Grade 1 coal-tar creosote should be used, and under no circumstances should coal-tar be added to creosote of this grade.

## SPECIFICATIONS FOR CREOSOTED WOOD BLOCK OIL ADOPTED BY THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, 1916.

**Kind.**

The preservative to be used may be either a coal-tar paving oil "A" or a coal-tar distillate oil "B" as herein specified.

**"A" Coal-Tar Paving Oil.**

The oil shall be a coal-tar product of which at least 65% shall be a distillate of coal-gas tar or coke-oven tar, and the remainder shall be refined or filtered coal-gas tar or coke-oven tar. It shall comply with the following requirements:

(1). It shall not contain more than 3% of water.

(2). It shall not contain more than 3% matter insoluble in benzol.

(3). The specific gravity of the oil at 38° C. shall not be less than 1.07 nor more than 1.12.

(4). The distillates based on water free oil shall be within the following limits:

Up to 210° C. not more than 5%
Up to 235° C. not more than 25%

The residue above 355° C., if it exceeds 35%, shall have a float test of not more than 80 sec. at 70° C.

(5). The specific gravity of the fraction between 235° and 315° shall not be less than 1.02 at 38°/15.5° C.

The specific gravity of the fraction between 315° and 355° shall not be less than 1.09 at 38°/15.5° C.

(6). The oil shall not yield more than 10% coke residue.

**"B" Coal-Tar Distillate Oil.**

The oil shall be a distillate of coal-gas tar or coke-oven tar, and shall comply with the following requirements:

(1). It shall not contain more than 3% of water.

(2). It shall not contain more than 0.5% of matter insoluble in benzol.

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(3). The specific gravity of the oil at 38° C. shall be not less than 1.06.

(4). The distillates based on water-free oil shall be within the following limits:

Up to 210° C. not more than 5%
Up to 235° C. not more than 15%

The residue above 355° C., if it exceeds 10%, shall have a float test of not more than 50 sec. at 70° C.

(5). The specific gravity of the fraction between 235° and 315° shall be not less than 1.02 at 38°/15.5° C.

The specific gravity of the fraction between 315° and 355° shall be not less than 1.09 at 38°/15.5° C.

(6). The oil shall yield not more than 2% of coke residue.

**Water-Gas Tar.**

In view of the fact that some cities are using the water-gas tar, your Committee (Committee on Wood Block Pavements of the American Society of Municipal Improvements) deems it advisable to suggest a specification for their guidance. This specification is the one submitted and agreed to by Mr. C. N. Forrest, Chemist, Barber Asphalt Paving Co., and Mr. W. H. Fulweiler, Chemist, United Gas Improvement Co., and is as follows:

The preservative shall be refined water-gas tar and shall comply with the following requirements:

(1). The specific gravity shall be not less than 1.12 nor more than 1.14 at 38° C., referred to water at the same temperature.

(2). Not more than 2% shall be insoluble by hot extraction with benzol and chloroform.

(3). On distillation, which shall be made as hereinafter described, the distillate based upon water free oil shall be within the following limits:

Up to 210° C., not more than 5%
Up to 235° C., not more than 15%
Up to 315° C., not more than 40%
Up to 355° C., not less than 25%

(4). The specific gravity of the total distillate below 355° C., shall not be less than 1.00 at 38° C., referred to water at the same temperature.

(5). The oil shall not contain more than 2% water, and due allowance shall be made for all water and insoluble foreign matter it may contain, by injecting a corresponding additional quantity into the blocks.

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## SPECIFICATIONS FOR PRESERVATIVE OILS, NATIONAL ELECTRIC LIGHT ASSOCIATION (1911).

### "A" Specification Covering Coal-Tar Creosote Oil.

The material required under this specification is that commonly known as dead oil of coal tar or coal-tar creosote. More specifically defined it is:

*a.* A distillate from tar produced as a by-product in the manufacture of coal-gas from bituminous coal by the retort method.

*b.* A distillate from the tar produced as a by-product in the manufacture of coke from bituminous coal by the byproduct coke-oven process.

*c.* A distillate obtained from a mixture of the above mentioned tars.

*d.* A product obtained by mixing distillates from the above mentioned tars.

It is understood that the presence of any hydrocarbons other than the above, either in the original tars or in the distillates therefrom, will, by defeating the purpose of this specification, which is to secure a pure distillate oil from coal-gas or coke-oven tar, be looked upon as an adulteration, which may result in the rejection of the oil. As further defining the material required, the hydrocarbons specifically provided against include the following:

*e.* Raw or partly distilled tars or petroleum oils of any description whatsoever, such as coal-tar, coke-oven tar, water-gas tar, oil-tar, lignite-tar, blast-furnace tar, producer-tar, wood-tar and crude petroleum.

*f.* Distillates from any of the above mentioned tars or oils, except distillates from coal-tar and coke-oven tar.

*g.* Residues from any of the above mentioned tars or oils.

*h.* Products obtained by filtration of any of the above mentioned tars or oils.

The purchaser of the treated timber, or his representative, shall have the right to take samples of the oil from the oil tanks or from the treating cylinders at the treating plant and to test such samples whenever or wherever desired. The oil may be refused upon satisfactory evidence that it does not conform to the specifications. In the event of a dispute between the purchaser of the treated timber and the firm treating the same the matter shall be referred to a referee mutually agreed upon by a representative of the purchaser and the manufacturer, and the decision of the referee shall be binding and final.

Information as complete as possible shall be furnished to the purchaser upon request as to the origin and history of the oil.

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PHYSICAL AND CHEMICAL CHARACTERISTICS.—The oil required under this specification must, in addition to being of satisfactory origin, possess certain physical and chemical characteristics, which are as follows:

(1). It shall have a specific gravity of at least 1.03 and not than 1.08 at 38° C. If the gravity is taken at a higher temperature a correction of 0.0008 for each degree Centigrade above 38° shall be made.

(2). There shall not be over 1% of residue insoluble in hot benzol.

(3). The original oil shall not contain over 2% of water.

(4). The oil shall be miscible in absolute alcohol volume for volume.

(5). The residue remaining upon sulphonating a portion of the total distillate shall not exceed 1%.

(6). The oil shall contain not more than 8% of tar acids.

(7). When 200 grams of the oil are distilled in accordance with the requirements of the specifications for the analysis of coal-tar dead oil or coal-tar creosote and the results calculated to water-free oil:

*a*. Not more than 5% of the oil shall distill off up to 205° C.

*b*. Not more than 35% of oil shall distill off at 235° C.

(Note: The percentage distilling to 245° and 270° C., shall be noted.)

*c*. Not more than 80% shall distill off at 315° C.

*d*. The coke residue shall not exceed 2%.

*e*. The distillate between 205° C. and 235° C. shall deposit naphthalene on cooling to 15° C.

**"B" Specification Covering Mixed Oils.**

The material required under these specifications is a homogeneous mixture of a distilled product obtained from coal-gas tar or coke-oven tar and generally known as coal-tar dead oil or coal-tar creosote with certain other hydrocarbons. More specifically defined, the added material, which must constitute not more than 40% of the final mixture may consist of:

*a*. Raw or partly distilled coal-tar, coke-oven tar, water-gas tar, lignite tar, blast-furnace tar, and producer tar.

*b*. Distillates from any of the above mentioned tars.

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*c.* Products obtained by filtration of any of the above mentioned tars.

As further defining the material required, it is understood that the presence in the oil of any of the hydrocarbons given below will, by defeating the purpose of this specification, which is to secure a mixed oil containing certain hydrocarbons, be looked upon as an adulteration, and the oil may be rejected. The oils provided against are as follows:

*d.* Petroleum oil or distillates or of residues therefrom.

*e.* Water-gas tar containing over 10% paraffine oil.

f. Oil tar containing over 10% paraffine oil.

*g.* Distillates or residues from water-gas tar or oil tar containing over 10% paraffine oil.

PHYSICAL AND CHEMICAL CHARACTERISTICS.—The oil required under this specification must have the following characteristics:

(1). It shall have a gravity of at least 1.04 and not more than 1.10 at 38° C.

(2). There shall be not over 3% of residue insoluble in hot benzol.

(3). The oil shall contain not over 3% of water.

(4). The residue remaining upon sulphonating a portion of the total distillate shall not exceed 5%.

(5). The oil shall contain not less than 2% nor more than 8% of tar acids.

(6). When 200 grams of the oil are distilled in accordance with the requirements of the specifications, herein referred to, and the results calculated to water-free oil:

*a.* Not more than 3% of oil shall distill off at 205° C.

b. Not more than 25% of oil shall distill off at 235° C.

(Note: The percentage distilling to 245° C., 270° C., and 360°C., shall be noted.)

c. Not more than 80% shall distill off to 315° C.

*d.* The residue above 360° C. shall not exceed 35%.

**"C" Specification Covering Water-Gas-Tar Creosote Oil.**

The material required under this specification is that known as dead oil of water-gas tar or water-gas-tar creosote. More specifically defined, it is:

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*a.* A distillate from tar produced as a byproduct in the manufacture of carbureted water gas from petroleum oil.

It is understood that the presence of any other hydrocarbon, either in the original tar or the distillate therefrom, will, by defeating the purpose of this specification, which is to secure a pure distilled oil from water-gas tar, be looked upon as an adulteration which may result in the rejection of the oil. As further defining the material required, the hydrocarbons specially provided against include:

*b.* Raw or partly distilled tar or petroleum oil of any description whatsoever, such as coal tar, coke-oven tar, water-gas tar, oil tar, lignite tar, wood tar, and crude petroleum.

*c.* Distillates from any of the above tars or oils, except distillates from water-gas tars.

*d.* Residues from any of the above mentioned tars or oils.

*e.* Products obtained by filtration of any of the above mentioned tars or oils.

PHYSICAL AND CHEMICAL CHARACTERISTICS.—The oil required under this specification must have the following characteristics:

(1). It shall have a specific gravity of at least 1.03 and not more than 1.08.

(2). There shall be not over 1% of residue insoluble in hot benzol.

(3). The oil shall contain not over 2% of water.

(4). The residue remaining upon sulphonating a portion of the total distillate shall not exceed 5%.

(5). When 200 grams of oil are distilled in accordance with the requirements of the specification of analysis, herein referred to, and the results calculated to water-free oil:

*a.* Not more than 2% of oil shall distill off at 205° C.

*b.* Not over 10% of oil shall distill off up to 235° C.

(Note: The percentage distilling to 245° and 270° C. shall be noted.)

*c.* Not more than 60% shall distill up to 315° C.

*d.* The coke residue shall not exceed 2%.

Your Sub-Committee presents for information the following methods for analysis of preservatives which have been adopted by other associations and societies having committees on preservative subjects:

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**Zinc Chloride.**

No methods of analysis for zinc chloride are given by the American Railway Engineering Association, the National Electric Light Association, or the American Society for Testing Materials.

The following method of analysis of zinc in treated timber is taken from the Manual of the A. R. E. A. for 1915:

## A. R. E. A. DETERMINATION OF ZINC IN TREATED TIMBER.

**Taking Sample.**

(1). The tools necessary for taking samples are a cross-cut saw and a 1-in. auger. These should be wiped perfectly clean each time before taking a sample in order to avoid contaminating the samples.

(2). The timbers from which samples are to be taken for analysis should be selected before the charge is loaded and carefully weighed individually. They should be of average size and comparatively free from knots. After treatment they should be weighed and then piled until the dripping has stopped, when the samples may be taken.

(3). For ordinary determinations timbers such as ties should be sawed at two points, viz., 2 ft. from the end and at the center of the tie. Each section should be designated section No. 1 and section No. 2, respectively. In special cases where it may be necessary to cut a tie into several sections the exact distance from the end of each section should be given.

(4). When a large number of ties are to be analyzed it will be sufficient to cut but one section 2 ft. from the end, thereby saving the 6-ft. piece for a narrow gauge tie.

(5). After the sections have been cut, three samples should be taken from each section as follows: No. 1, ½ in. from outside; No 3, at the center of the section; No. 2, halfway between No. 1 and No. 3. The samples are taken by boring a hole 2 ins. deep with a 1-in. bit saving all the borings. Each sample should be properly labelled as tie No. ——, section No. ——, sample No. ——, and a list made showing the location, date, number of run, kind of treatment, and weight of each tie before and after treatment.

**Method of Determining Zinc Chloride in Samples.**

(6). Three grams of dry borings should be weighed into a 250 c.c. flask, and 3 c.c. of concentrated sulphuric acid added. The flask should be gently heated on a sand bath or hot plate until the wood becomes thoroughly charred. A few drops

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of concentrated nitric acid should then be added. When the brown fumes have disappeared, a few more drops should be added, and the addition continued, a few drops at a time (toward the last the amount should be increased), until the organic matter is all destroyed. When this point is reached, the liquid will remain colorless on further heating. The flask should then be allowed to cool and be diluted with 100 c.c. of water (the water should be added carefully at first).

As a rule, the residue in the flask will be completely dissolved, but if there should be a slight sediment it may be disregarded.

Ammonium hydroxide should be added until distinctly alkaline and allowed to cool. If there is a precipitate of iron hydroxide, or if there has been any undissolved sediment in the flask, it should be filtered; if not, it should be poured into a 400 c.c. beaker and 5 c.c. ammonium sulphide added and allowed to stand over night. It should then be filtered into an 11 c.m. filter paper; washed thoroughly with water containing ammonium sulphide and dried. It should then be incinerated in a porcelain crucible and roasted until the zinc sulphide is converted into zinc oxide.

The weight should be divided by 3 and the result multiplied by 1.674, which will give the number of grams of zinc chloride contained in 1 gram of wood examined, or the number of pounds per pound. To convert this result into pounds of zinc chloride per cubic foot of wood multiply by the weight in pounds of 1 cu. ft. of the wood.

**Sampling Wood-Preserving Oils.**

The method of sampling from A. R. E. A. Manual, 1915, is as follows:

The sample taken for analysis shall be strictly average of the whole bulk of the oil to be tested. The oil shall be completely liquefied and well mixed before samples are taken. Whenever possible a drip sample of not less than 2 gals. shall be taken, commencing after the oil has started to run freely. When this cannot be done, as for instance in large storage tanks, samples shall be taken from various depths in the tank by means of a tube or bottle, the number of samples depending on local conditions.

For taking samples during the process of treatment, a sample of oil shall be taken from the storage tank about 1 ft. from the bottom of the tank before the cylinder is filled, and, where possible, a sample directly from the cylinder during the process of treatment. For this purpose a thermometer well may be used. The sample to be analyzed shall be thoroughly liquefied by heating until no crystals adhere to a glass stirring rod, and also well shaken,

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after which one-half shall be taken for analysis and the balance reserved for a check test.

Method of sampling taken from the N. E. L. A. Proceedings, 1911 is as follows:

One gallon sample of oil shall be taken for analysis, the manner of collecting the same depending on the nature of storage. The oil must be completely liquid when the sample is taken and it may, therefore, be necessary to heat the tank or other receptacle in which it is contained. The following general rules shall be observed when sampling from:

*(a)* TANK BOAT.—The sample shall be taken from the pumping system while discharging from the boat into the receiving tank as follows:

A ½-in. cock shall be placed in the line at any convenient point and a continuous stream of oil drawn through this cock during the entire time of emptying the boat. The rate of flow of the stream shall be proportionate to the rate of flow of oil in the pumping line, and it should be such that a gallon sample may be collected for each 10,000 gals. of oil passing through the pipe. The bulk sample thus obtained, which may be caught in a barrel or other suitable receptacle provided for the purpose, shall be thoroughly mixed and shall, if necessary, be heated to bring into solution any material which may have crystallized out. A 1-gal. sample shall be taken from this for analysis.

*(b)* STORAGE TANKS LESS THAN 20 FT. IN DEPTH.—In sampling from storage tanks of less than 20 ft. in depth a "thief" shall be employed. It shall be made of a length of ½-in. pipe provided at the lower end with a lever-handle cock having an opening of approximately the same size as the interior of the pipe. This pipe being open the thief is lowered slowly into the tank, and when it has touched bottom the cock is closed by means of a chain, wire, or iron rod carried to the top of the pipe. A sufficient number of samples thus procured shall be taken to aggregate 1 gallon.

*(c)* STORAGE TANKS OVER 20 FT. IN DEPTH.—Samples shall be taken from such tanks through ½-in. cocks placed one above the other and 1 ft. apart on the side of the tank. One gallon of oil shall be withdrawn from each level, and the bulk sample thus obtained shall be thoroughly mixed as in *(a)* and the final sample taken from this.

*(d)* TANK CARS.—Drip samples shall be taken from tank cars as in *(a)*.

*(e)* TREATING CYLINDERS.—Samples from treating cylinders shall be taken from the charging and discharging line as in *(a)*.

Tentative method for sampling, A. S. T. M., 1915:

1. Whenever the oil is being loaded or discharged by means of a pump the following method shall be used:

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The pipe-line through which the material is being pumped shall be tapped on the discharge side of the pump, preferably in a rising section of the pipe-line. The sample shall be taken by means of a ½-in. pipe extending halfway to the center of the main pipe and the inlet of the ½-in. pipe shall be turned to face the flow of the liquid. This pipe shall discharge into a barrel or drum of 50 or 100 gals. capacity, and the plug cock regulated so as to secure a continuous uniform stream during the entire pumping of the shipment. The barrel, or preferably the iron drum, should be provided with a small steam coil sufficient to keep the content thoroughly liquid. The temperature shall not exceed 120° F. The contents of the barrel or drum shall be very thoroughly agitated and small samples for testing taken immediately. The amount of the drip sample collected shall be not less than 1 gal. for each 1,000 gals. of material handled, excepting in the case of large boat shipments where a maximum of 100 gals. will suffice.

2. In sampling from storage tanks it is necessary to secure samples from different levels, and where possible this may be done by means of small outlet cocks at regular intervals from the top to the bottom of the storage tank. In such cases about 1 gallon of oil shall be drawn from each outlet cock and thoroughly mixed and a portion taken for testing. The stream from each cock shall always be allowed to flow for sufficient length of time to empty the outlet pipe and nipple before commencing to collect the sample. When tanks have no outlet cock a vessel having a string attached to the cork may be lowered to a measured depth representing a number of different levels in the tank and the cork removed when the vessel has reached the proper level. These samples shall be combined for an average as above.

3. The method of sampling tank car shipments is under investigation by the society.

**Determination of Moisture.**

Methods suggested by manufacturers of oil:

*(a.)* When it is not desired to make further examination the apparatus to be used is shown in Figs. 5 and 6. Measure 50 c.c. of coal-tar naphtha or light oil (which must be tested to determine that it is free from water whenever a new supply is received) in a 250 c.c. cylinder. Add 200 c.c. of creosote. Transfer contents of cylinder to copper still and wash the cylinder with 50 to 75 c.c. more of naphtha, adding the washings to the contents of the still. Attach lid and clamp using a paper gasket, and set up apparatus as shown in Fig. 5. Apply heat by means of the ring burner, and distill until the vapor temperature, as indicated by the thermometer, has reached 205° C. The distillate is collected in a separatory funnel, to which 15 to 20 c.c. benzol has been previously added. This effects a clean separation of oil and water. The reading is made after twirling the funnel and allowing to settle for a few minutes. The percentage of water is taken by volume.

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*(b.)* When it is required for further test the oil is dried by taking about 500 c.c. in the apparatus used for water determination, but without the addition of naphtha. The distillation is carried to 205° C. vapor temperature. Any oil which has distilled over is separated from the water (warming the separatory funnel, if necessary) and returned to the still.

**Specific Gravity.**

Method taken from the A. R. E. A. Manual, 1915:

In order to determine the specific gravity of any oil simply heat the oil in a water bath until it is completely liquefied. A glass stirring rod dipped into the oil should show no solid particle on the rod when the same is withdrawn from the oil. When completely liquefied it should be stirred thoroughly and the hydrometer cylinder which has been previously warmed filled. Insert a specific gravity hydrometer of good make, taking care that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken. This reading should preferably be taken when the oil is at 38° C., because at this temperature almost all oils are completely liquid. When contract requirements specify a specific gravity at a different temperautre such gravity is obtained by multiplying 0.0008 by the number of degrees Centigrade, or 0.00044 by the number of degrees Fahrenheit, the oil is found to be above the temperature required by the contract and adding the product to the observed gravity.

Method taken from the A. S. T. M. Proceedings, 1915-16:

*(a)* HYDROMETER.—The hydrometer shall be of the form and dimensions shown in Fig. 8.

*(b)* CYLINDER.—The cylinder shall be of the form and dimensions shown in Fig. 9. A standardized hydrometer shall be used. A set of two with ranges 1.00 to 1.08 and 1.07 to 1.15 will suffice. The oil shall be brought to a temperature of 38° C., and the determination shall be made at that temperature unless the oil is not entirely liquid at 38° C.

In case the oil requires to be brought to a higher temperature than 38° C., in order to render it completely liquid, it shall be tested at the lowest temperature at which it is completely fluid and a correction made by adding 0.0008 to the observed specific gravity for each degree Centigrade above 38° C., at which the test is made. This correction factor does not apply with equal accuracy to all oils, but serious error, due to its use, will be avoided if the foregoing precaution is observed with respect to avoiding unnecessarily high temperatures.

Before taking the specific gravity the oil in the cylinder should be stirred thoroughly with a glass rod, and this rod when withdrawn from the oil should show no solid particles at the instant of withdrawal. Care should be

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taken that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken and that the oil surface is free from froth and bubbles.

**Distillation Test.**

Test taken from the A. R. E. A. Manual, 1915:

The apparatus for distilling creosote shall consist of a stoppered glass retort similar to that shown in Figs. 10 and 12, having a capacity as nearly as can be obtained of 8 oz. up to bend of the neck when the bottom of the retort and the mouth of the off-take are in the same plane. A nitrogen filled mercury thermometer of good standard make divided into full degree Centigrade shall be used in connection therewith.

In order to insure uniform results for comparative purposes the length of the thermometer bulb shall be ½ in. but in no case shall a thermometer with a long bulb be used. The bulb of the retort and at least 2 ins. of the neck shall be and remain covered with a shield of heavy asbestos paper, shaped as shown in Fig. 12 during the entire process of distillation, so as to prevent heat radiation. Between the bottom of the retort and the flame of the lamp or burner two sheets of wire gauze, each 20-mesh fine and at least 6 ins. square, shall be placed. The flame shall be protected against air currents. An ordinary tin can from which a portion of the bottom and all of the top have been removed placed on a support attached to the burner, as shown in Fig. 12, will answer the purpose.

Before beginning the distillation the retort shall be carefully weighed and exactly 100 grams of oil placed therein, the same being weighed in the retort. The thermometer shall be inserted in the retort with the lower end of the bulb ½ in. from the surface of the oil and the condensing tube attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube shall not be less than 20 ins., nor more than 24 ins., and during the process of distillation the thermometer shall remain in the position in which it was originally placed. The distillate shall be collected in weighed bottles and all fractions determined by weight.

Report shall be made on the following fractions:

0 to 170°
170 to 200°
200 to 210°
210 to 235°
235 to 270°
270 to 315°
315 to 355°
Residue above 355° C.

Reports shall be made on individual fractions. In making such reports it is to be distinctly understood that these fractions do not necessarily refer to individual com-

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pounds. In other words, the fraction between 210 and 235 will not necessarily be all naphthalene, but will probably contain a number of other compounds.

The distillation shall be continuous and should require about 45 minutes. When any measurable quantity of water is present in the oil the distillation shall be stopped, the oil separated from the water and returned to the retort, when the distillation shall be recommended and the previous readings discarded.

In obtaining water-free oil it is desirable to free about 300 to 600 c.c. of the oil by using a large retort and 100 grams of the water-free oil for the final distillation. In the final report as to fractions a correction shall be made of the amount of water remaining so that the report may be made on the basis of dry oil.

Test taken from the N. E. L. A. Proceedings, 1911:

*(a)* FLASK.—The flask required is a Lunge side-necked distilling flask provided with a trap (Fig. 1) and having a tubular 30 c.m. long placed close to the bulb. The flask must have a capacity of 300 c.c. when filled to a height equal to its maximum diameter.

*(b)* THERMOMETER.—The thermometer must be of Jena glass and be nitrogen filled, and graduated at intervals of 1 m.m. in singles degrees, the scale reading to 400° C.

*(c)* RECEIVERS.—The glass receivers may be of any convenient shape and size. One hundred cubic centimeter Erlenmeyer flasks are, however, recommended.

*(d)* SHIELD.—A shield 10 c.m. in diameter and 8 c.m. high, made of asbestos, must be provided.

*(e)* SUPPORT FOR FLASK.—The flask must rest on an asbestos board ½ c.m. in thickness by 15 c.m. in diameter, a hole 5 c.m. in diameter being cut in the center of the board. The board shall rest on a ring stand.

The apparatus must be assembled as shown in Fig. 2. The thermometer passes through a cork in the top of the flask, and is so placed that the top of the bulb of the thermometer is on a line with the bottom of the tubular outlet. The asbestos shield is placed around the bulb of the flask, and the flask mounted on the asbestos board supported on the ring stand, as shown in Fig. 2.

Two hundred grams of oil shall be used in the analysis, this amount being weighed on a balance sensitive to 1 m.g. in the following manner:

The flask is first placed on the pan of the balance and weighed and the weight recorded. Without removing the flask a 200-gram weight is placed on the opposite pan of the balance and a sufficient quantity of oil dropped into the glass through a long stem funnel to bring the pans into equilibrium. The flask is then removed from the balance and set up as shown in Fig. 2. Care must be taken that

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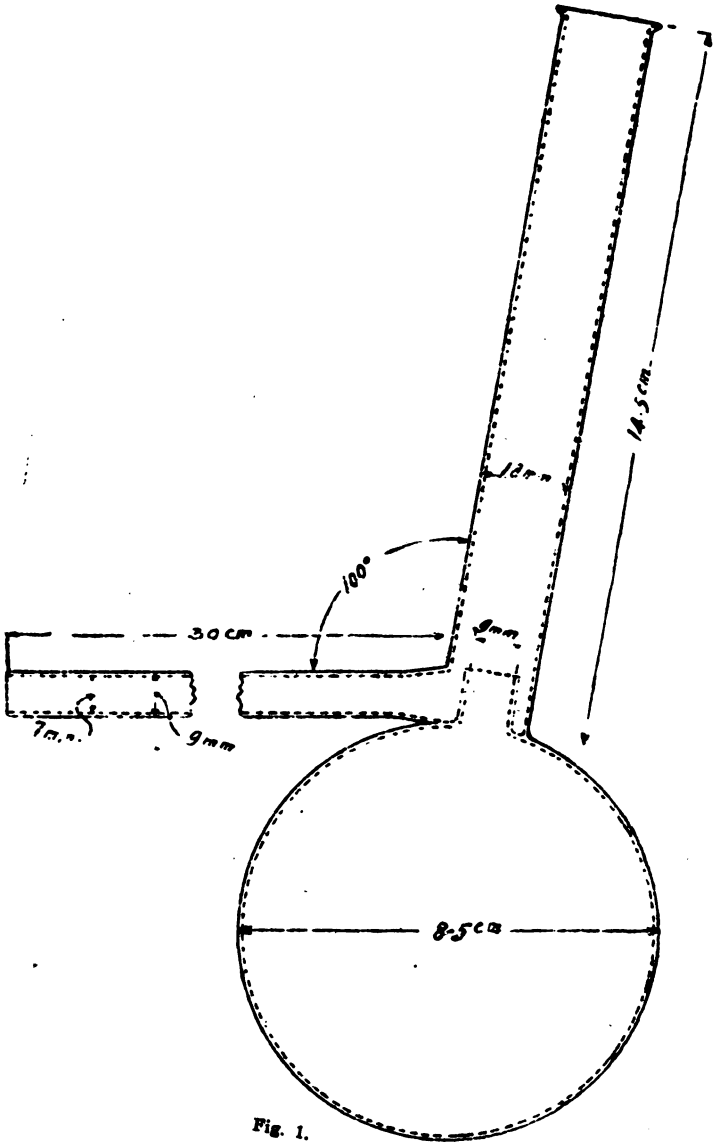


Fig. 1.

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the cork stopper carrying the thermometer fits tightly into place. The flask should be heated, preferably by a Bunsen

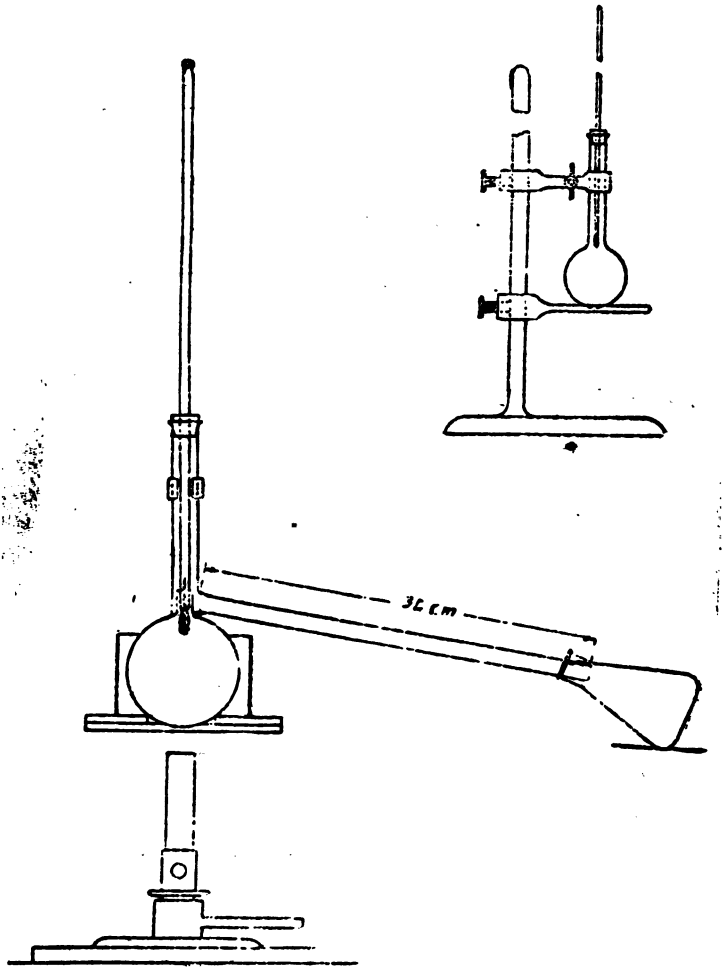


Fig. 2.

or other standard form of gas burner. The distillation shall be continuous and at such a rate that two drops of oil per second leaves the end of the tubular after the thermometer registers 205° C. or after all the water has been driven off.

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The percentage weights of the following fractions shall be recorded:

To 205° C.
To 235° C.
To 245° C.
To 270° C.
To 315° C.
To 360° C.

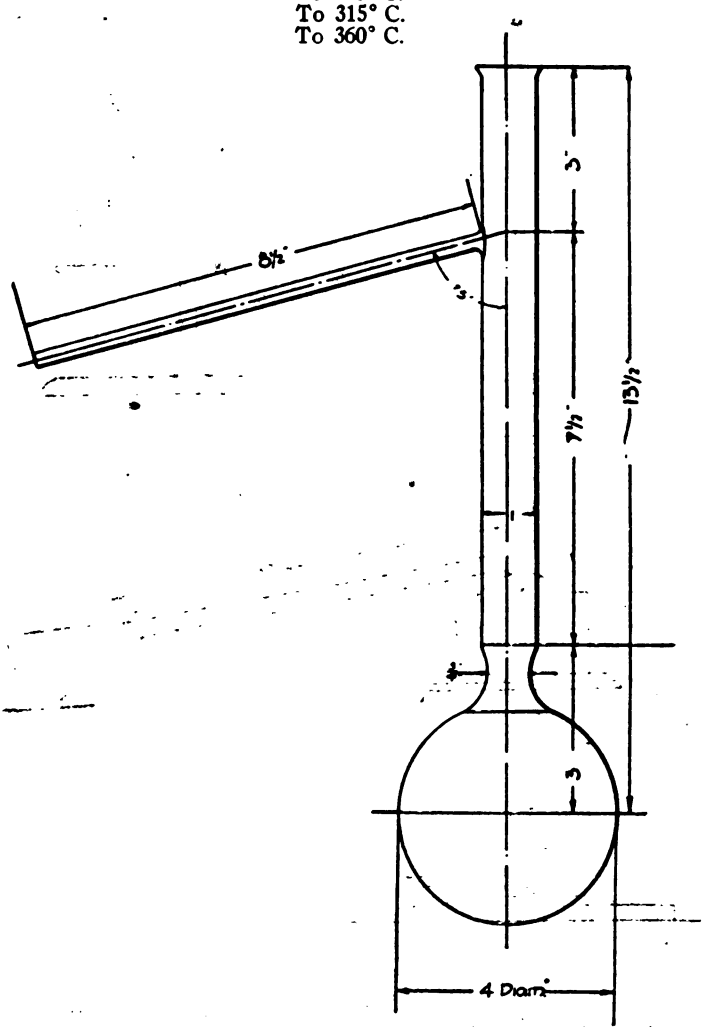


Fig. 3.

Hempel flask distillation, Forest Service method of testing:

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The flask used for this test is shown in Fig. 3. The specifications for the flask are as follows:

(1). The flask must be of Jena glass or its equivalent.

(2). The size of the flask must not vary more than 1/16 in. from the dimensions given in the figure, except the bulb which must contain approximately 500 c.c.

(3.) The complete apparatus should weigh approximately 175 grams.

In setting up the apparatus for distillation a loose plug of wire or other suitable arrangement for holding beads is dropped into the flask and lodged against the restriction at the neck of the flask. Approximately 200 large beads are placed above the plug of wire. The height of the bead column so formed must be exactly 5 ins. with a tolerance of 1/8 inch. The thermometer is placed in such manner that the top of the bulb (if the thermometer has a secondary bulb then this point must be taken in place of the top of the bulb) is just below the side outlet. A short air condenser is used.

The flask is placed on an asbestos board in which is cut a large hole slightly smaller than the great[illegible]meter of the flask. This hole is further enlarged by [illegible]ber of triangular notches. The bulb of the flask is protected from drafts by a cylinder of asbestos paper 2 ins. high fitted with a cover, in the center of which a hole is provided for the Hempel column to protrude above the shield.

The distillation is run at the rate of between 60 and 120 drops per minute. Two hundred and fifty grams of oil is used for each distillation, and fractions are taken every 10°, beginning with 205° until 315° has been reached. Beyond that point the fractions are 330 and 360 degrees C., etc. This method is not intended for control work at the plant so much as a method to be used for purchase and sale of materials and for scientific investigation work.

**Tar Acids.**

Method of testing from A. R. E. A. Manual, 1915:

For the determination of low-boiling tar acid the fractions should be placed in the separating funnel, to which has been added 30 c.c. of 15% hot sodium hydroxide solution, vigorously shaken, and allowed to stand until the dissolved phenols separate and are drawn off; after which repeat with successive sodium hydroxide solutions, 20 c.c. each time, until no phenols are left (the sodium solution comes off clear). The phenols so obtained should be separated by the addition of 25% sulphuric acid slowly stirred in. When this reaction is complete the phenols so obtained should be decanted and weighed.

Method of testing from N. E. L. A. Proceedings, 1911:

One hundred cubic centimeters of the total distillate to 315° C., to which has been added 40 c.c. of a solution

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of sodium hydroxide having a specific gravity of 1.15, is warmed slightly and placed in a separatory funnel. The mixture is vigorously shaken, allowed to stand until the oil and soda solutions separate, and the soda solution containing most of the tar acids drawn off. A second and third extraction is then made in the same manner using 30 and 20 c.c. of the soda solution, respectively. The three alkaline extracts are united in a 200 c.c. graduated cylinder and acidified with dilute sulphuric acid. The mixture is then allowed to cool and the volume of tar acids noted. The results shown to be calculated to the original oil.

A revision of the test of the American Society for Treating Materials is being considered by that society.

**Sulphonation Test.**

Test according to the Forest Service method of testing:

Ten cubic centimeters of the fraction of creosote to be tested are measured into a Babcock milk bottle. To this is added 30 to 40 c.c. of 37 times normal sulphuric acid, 10 c.c. at a time. The bottle with its contents is shaken for two minutes after each addition of 10 c.c. of acid. After all the acid has been added to the bottle it is kept at a constant temperature of from 98° to 100° C. for one hour, during which time it is shaken vigorously every 10 minutes.

At the end of an hour the bottle is removed, cooled, and filled to the top of the graduation with ordinary sulphuric acid and then whirled for 5 minutes in a Babcock separator. The unsulphonated residue is then read off from the graduations. The reading of the major graduation multiplied by 2 gives the per cent. by volume directly.

Test taken from N. E. L. A. Proceedings, 1911:

Ten cubic centimeters of the total distillate to 315° C. are placed in a flask and warmed with four to five volumes of concentrated sulphuric acid to 60° C. and the whole transferred to a graduated separatory funnel (Fig. 4).

The flask is rinsed three times with small quantities of concentrated sulphuric acid and the rinsings added to the contents of the funnel, which is then stoppered and shaken cautiously at first, afterwards vigorously for at least 15 minutes and allowed to stand over night. The acid is then carefully drawn down into the graduated portion of the funnel to within 2 c.c. of where the unsulphonated residue shows. If no unsulphonated residue is visible the acid should be drawn down to 2 c.c.

In either case the test should be carried farther as follows:

Add 25 c.c. of water and allow to stand for one-half hour, then draw off the water as close as possible without drawing off any supernatent oil or emulsion. Add 10 c.c.

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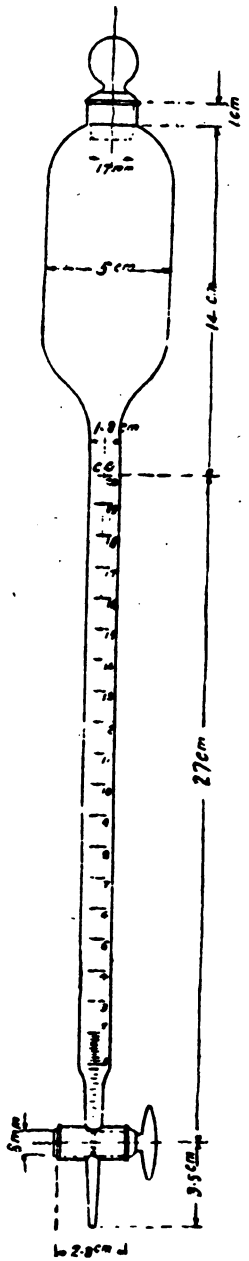


Fig. 4.

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of strong sulphuric acid and allow to stand for 15 or 20 minutes. Any unsulphonated residue will now separate out clear and give a distinct reading. If under 0.2 c.c. it should be drawn down into the narrow part of the funnel to just above the stop cock where it can be estimated to 0.01 c.c. The volume of residue thus obtained is calculated to the original oil.

**Determination of Free Carbon or Insoluble Matter.**

Test taken from the Proceedings of the N. E. L. A.:

The apparatus required is as follows:

Knorr condenser, Knorr flask, S. & S. No. 575 filter paper, 15 c.m. in diameter, wire for supporting filter paper.

Ten grams of the oil should be weighed in a small beaker and digested with c.p. toluol on the steam bath. A cylindrical filter cup is prepared by folding two of the papers around a rod 5/8 in. in diameter. The inner paper should be cut to 15 c.m. diameter. Prior to using the filter papers they should have been extracted with benzol to render them fat-free. The filter cup is dried at 100 c.c. and weighed in a weighing bottle.

The contents of the beaker are now decanted through the filter cup, and the beaker washed with hot toluol passing all washings through the cup. The filtrate should be passed through the filter a second time. The residue washed two or three times with hot c.p. benzol and transferred to the extraction apparatus in which c.p. benzol is used as a solvent which is vaporized by means of a steam or water bath. The extraction is continued until the filtrate is colorless. The filter cup is then removed, dried, and weighed in the weighing bottle. Chemically pure benzol followed by chloroform may be used instead of c.p. toluol followed by benzol.

Tentative method suggested by the A. S. T. M., 1916:

*(a.)* The extractor shall be of the form shown in Fig. 7, or any similar form in which the oil is subjected to direct washing by the boiling vapors of the solvent.

*(b.)* The filtering medium may be either two thicknesses of S. & S. No. 575 hardened filter paper, 15 c.m. in diameter, arranged in cup-shape by folding symetrically or alundum thimbles flat bottom 30 by 80 R. A. 98.

If filter papers are used, prior to using they should be soaked in benzol to remove any grease, dried in a steam oven and kept in a dessicator until ready to be used. The filter paper cup may be suspended in the extractor flask by a wire basket hung from two small hooks on the under surface of the metal cover of the flask. If the alundum thimble is used it may be supported by two perforations at the top of the thimble and suspended from the cover by German silver or platinum wires.

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Weigh 10 grams of dry oil into 100 c.c. beaker. Add 50 c.c. of pure benzol and transfer at once to the filter cup. The filter cup or thimble is previously weighed, and the paper cup should always be kept in a weighing bottle until ready for use. Wash out the beaker with benzol, passing all washings through the filter cup and place latter at once in the extraction apparatus. The extractor shall contain a suitable quantity of pure benzol. Sufficient heat to boil the solvent shall be provided by means of an electric heater or steam bath. Continue the extraction until the descending solvent is practically colorless and remove the filter cup and dry in steam oven until all solvent is driven off. Cool in desiccator and weigh. The balance for this purpose should be accurate to within .5 of a milogram.

**Naphthalene Test.**

Test taken from A. R. E. A. Manual, 1915:

The fractions remaining after extraction of phenols from the distillate should be placed in a conical vessel, such as a graduate and surrounded by freezing mixture of ice and salt, and allowed to remain until completely frozen. The naphthalene so frozen should be chopped up with a knife or mashed and placed into a small brass cylinder about 1½ ins. in diameter by 4 ins. long, open at both ends, but fitted with small brass plates or plugs.

Before putting the naphthalene, place several thicknesses of blotting paper, cut to fit the cylinder, on the bottom of the plate, and before putting in the top plate introduce similar blotting pads. Place several sheets of blotting on a plate of a copper press. put cylinder so charged in the press and apply pressure to the top plate or plug, leaving it for one hour. A clean plug of clean naphthalene is the result and may be taken out and weighed.

**Coke Test.**

Test taken from N. E. L. A. Proceedings, 1911:

In making the coke determination hard glass bulbs similar to the one shown in Fig. 15 are to be used.

The test is to be carried out as follows:
Warm the bulb slightly to drive off all moisture, cool in a dessicator, and weigh. Again heat the bulb by placing it momentarily in an open Bunsen flame, and allow the bulb to cool until sufficient oil is sucked in to fill the bulb about two-thirds full.

Any globules of oil sticking to the inside of the tubular should be drawn into the bulb by shaking or expelled by slightly heating it. The outer surface should be carefully wiped off, and the bulb reweighed. This procedure will give about 1 gram of oil.

Cut a strip of thin asbestos paper about ¼ in. wide and 1 in. long. Place it around the neck of the bulb and attach the two free ends close up to the neck with a pair of crucible tongs. The oil should then be distilled off as in

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making an ordinary oil distillation, starting with a very low flame and conducting the distillation as fast as can be maintained without spurting.

When oil ceases to come over the heat should be increased until the highest temperature of the Bunsen flame is obtained, the whole bulb being heated red hot until the evolution of gases cease and any carbon sticking to the outside of the tubular is completely burned off. The bulb should then be cooled in a dessicator and weighed and the percentage of coke residue calculated to water-free oil.

**Index of Refraction Values of the Fractions.**

Forest Service method of testing:

The instrument used for the determination of the index of refraction is known as the Abbey refractometer. Other refractometers are on the market, but this type of instrument is simplest and is more than sufficiently accurate for this purpose. It is so constructed that the prism of the instrument and, hence, the oil under examination can be kept at any desired temperature. For this work a temperature of 60° C. is used, because, at this temperature nearly all of the fractions are liquid. A higher temperature is not desirable because of the danger of injuring the instrument. The detail manipulation is omitted here, because it is believed it would only lead to confusion.

**Specific Gravity of the Fractions.**

A convenient method offered by the manufacturers of oil, also used by the Forest Service, is:

On account of the small size of the fraction, an ordinary specific gravity hydrometer cannot be used for this determination, the best instrument for this purpose being an ordinary Westphal balance with a plummet or bob of approximately 2 c.c. displacement. Instruments are made having this displacement which are accurate to one in the third decimal place, but they are somewhat more expensive than the ordinary Westphal balance. A smaller bob, can, however, be made with a little skill in glass blowing such as a chemist usually has, which will answer the purpose. Such a plummet will, of course, have a different displacement than the original one, and unless this is compensated for the readings will be of no value. The easiest way to compensate for this difference is by putting the instrument in balance when the plummet is immersed in water and the weights show a specific gravity of 1. This can be accomplished by the use of an additional weight at the end of the beam. Since no correction factors for transferring the specific gravity of the fractions from one temperature to another are available it is necessary that the gravity be taken at a standard temperature. This temperature is 60° C.

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## REPORT OF SUB-COMMITTEE B.

Instructions to this Sub-Committee were as follows:

Present for adoption:

Specifications for creosote oil for ties and structural timber.

Specifications for coal-tar oil for paving blocks.

One standard method for making each test required in determining whether a material meets the requirements of a specification.

Specifications recommended for adoption must be supported by the data on which they are based.

Specifications recommended for adoption are as follows:

**Creosote Oil for Ties and Structural Timber.**

*The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:*

*1. It shall not contain more than 3% of water.*

*2. It shall not contain more than 0.5% of matter insoluble in benzol.*

*3. The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.03.*

*4. The distillate, based on water-free oil, shall be within the following limits:*

*Up to 210° C. not more than 5%.*
*Up to 235° C. not more than 25%.*

*5. The specific gravity of the fraction between 235° C. and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.*

*The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.*

*6. The residue above 355°, if it exceeds 5%, shall have a float-test of not more than 50 seconds at 70° C.*

*7. The oil shall yield not more than 2% coke residue.*

*8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.*

**Creosote-Coal-Tar Solution for Ties and Structural Timber.**

*The oil shall be a coal-tar product, of which at least 80% shall be a distillate of coal-gas tar or coke-oven tar, and the remainder shall be refined or filtered coal-gas tar or coke-oven tar. It shall comply with the following requirements:*

*1. It shall not contain more than 3% of water.*

*2. It shall not contain more than 2% of matter insoluble in benzol.*

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*3. The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.05 or more than 1.10.*

*4. The distillate, based on water-free oil, shall be within the following limits:*

*Up to 210° C. not more than 5%.*
*Up to 235° C. not more than 25%.*

*5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.*

*The specific gravity of the fraction between 315° C. and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.*

*6. The residue above 355° C., if it exceeds 26%, shall have a float-test of not more than 50 seconds at 70° C.*

*7. The oil shall yield not more than 6% coke residue.*

*8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.*

**Coal-Tar Oil for Paving Blocks.**

*The oil shall be a coal-tar product, of which at least 65% shall be a distillate of coal-gas tar or coke-oven tar, and the remainder shall be refined or filtered coal-gas tar or coke-oven tar.*

*It shall comply with the following requirements:*

*1. It shall not contain more than 3% of water.*

*2. It shall not contain more than 3% of matter insoluble in benzol,*

*3. The specific gravity of the oil at 38° compared with water at 15.5 C. shall be not less than 1.07 or more than 1.12.*

*4. The distillate, based on water-free oil, shall be within the following limits:*

*Up to 210° C. not more than 5%.*
*Up to 235° C. not more than 25%.*

*5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.*

*The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.*

*6. The residue above 355° C. if it exceeds 35%, shall have a float-test of not more than 80 seconds at 70° C.*

*7. The oil shall yield not more than 10% coke residue.*

*8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.*

**Distillate Oil for Paving Blocks.**

*The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:*

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*1. It shall not contain more than 3% of water.*

*2. It shall not contain more than 0.5% of matter insoluble in benzol.*

*3. The specific gravity of the oil at 38°, compared with water at 15.5° C. shall be not less than 1.06.*

*4. The distillate, based on water-free oil, shall be within the following limits:*

*Up to 210° C. not more than 5%.*
*Up to 235° C. not more than 15%.*

*5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.*

*The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.*

*6. The residue above 355° C., if it exceeds 10%, shall have a float-test of not more than 50 seconds at 70° C.*

*7. The oil shall yield not more than 2% coke residue.*

*8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.*

The Committee recommends for adoption the following methods of testing:

## 1.—Water.

APPARATUS.—*Copper stills shown in Figs. 5 and 6—below:*

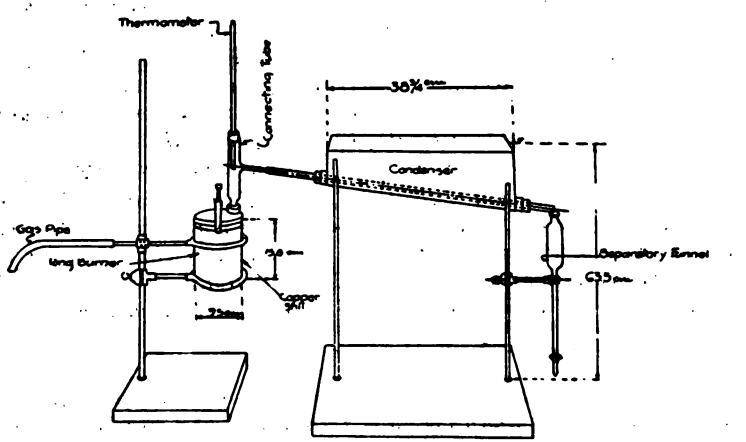


Fig. 5.

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Fig. 6.

METHOD.—*When any measurable amount of water is present in the distillate below 210°, on testing in accordance with Section 4, Distillation, the oil and water in this fraction shall be separated, if possible, and measured separately. If more than 2% of water is present, or if the water is apparently present to an extent in excess of 2%, but an accurate separation is impossible, the percentage of water present shall be determined by the following method, and the water-free oil so obtained shall be used in distillation test, as described under Section 4.*

*Measure 200 c.c. of oil in graduated cylinder, and pour into copper still, allowing the cylinder to drain into the still for several minutes. Attach lid and clamp, using a paper gasket slightly wet with oil around the flange of the still. Apply heat by means of the ring burner, which should be placed just above the level of the oil in the still at the beginning of the test, and gradually lowered when most of the water has distilled over. Continue the distillation until the vapor temperature indicated by the thermometer with the bulb opposite the offtake of the connecting tube, reaches 205° C. Collect distillate in separatory funnel.*

*When the distillation is completed, and a clear separation of water and oil in the funnel has taken place, the water is read by volume and drawn off, and whatever light oil has distilled over with the water is then returned to the oil in the still. The dehydrated oil from the still is then taken for distillation, described in Section 4, Distillation.*

### 2. Insoluble in Benzol.

APPARATUS.—(A) *Extractor may be of the form shown in Fig. 7, or any similar form in which the oil is subjected to direct washing by the boiling vapors of the solvent.*

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*(B) Filtering medium may be either two thicknesses of S. & S. No. 575 or Whatman No. 5 hardened filter paper, 15 c.m. in diameter*

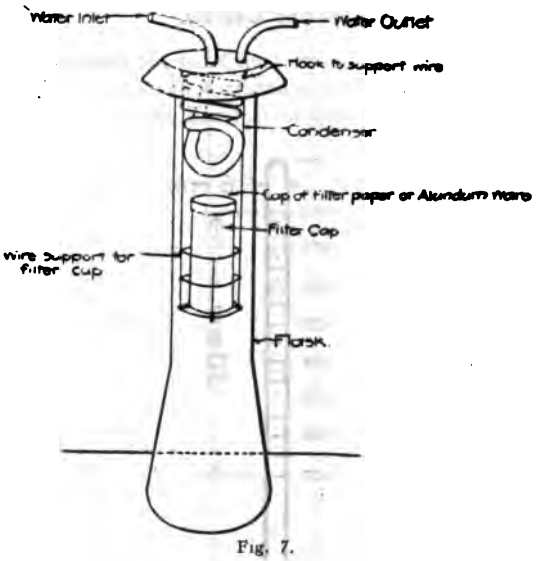


Fig. 7.

*arranged in cup-shape by folding symmetrically; or alundum thimbles, flat bottom, 30x80 RA 98. If filter papers are used, prior to using they shall be soaked in benzol to remove grease, dried in a steam oven and kept in a desiccator until ready to be used. The filter-paper cup may be suspended in the extractor flask by a wire basket hung from two small hooks on the under surface of the metal cover of the flask.*

*If the alundum thimble is used, it may be supported by making two perforations in the top of the thimble, and suspending from the cover by German silver or platinum wires.*

METHOD.—*Weigh 10 grams of dry oil in 100 c.c. beaker. Add about 50 c.c. of pure benzol, and transfer at once to the filter cup. The filter cup or thimble is previously weighed, and the paper cup shall always be kept in a weighing bottle until ready for use. Wash out the beaker with benzol, passing all washings through the filter cup, and place the latter at once in the extraction apparatus.*

*Extractor shall contain a suitable quantity of pure benzol. Sufficient heat to boil the solvent shall be provided by means of an electric heater or a steam bath.*

*Continue the extraction until the descending solvent is practically colorless, and remove the filter cup and dry in steam oven until all*

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*solvent is driven off; cool in desiccator and weigh. The balance used for this purpose should be accurate to 0.5 m.g.*

### 3. Specific Gravity.

APPARATUS.—(A) *Hydrometer shall be of the form and dimensions shown in Fig. 8. It shall be standardized at 15.5° C. A set of two with ranges 1.00 to 1.08 and 1.07 to 1.15 will suffice.*

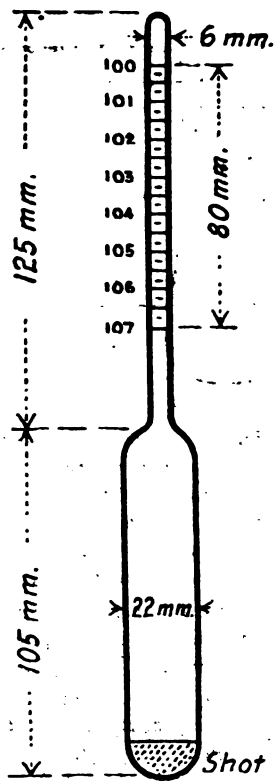


Fig. 8.

(B) *Cylinder shall be of the form and dimensions shown in Fig. 9.*

METHOD.—*The oil shall be brought to a temperature of 38° C. (100° F.), and the determination shall be made at that temperature unless the oil is not entirely liquid at 38° C. In case the oil requires to be brought to a higher temperature than 38° in order to render it completely fluid, it shall be tested at the lowest temperature at which it is*

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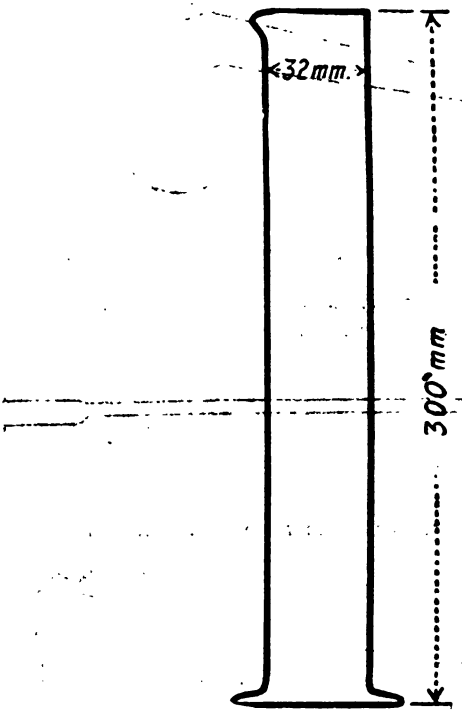


Fig. 9.

*completely fluid, and a correction made by adding 0.0008 to the observed specific gravity for each degree Centigrade above 38° C. at which the test is made. This correction factor does not apply with equal accuracy to all oils, but serious error, due to its use will be avoided if the foregoing precaution is observed, with respect to avoiding unnecessarily high temperature.*

### 4. Distillation.

APPARATUS.—(A) *Retort shall be a tubulated glass retort of the usual form with a capacity of 250 to 290 c.c. The capacity shall be measured by placing the retort with the bottom of the bulb and the end of the offtake in the same horizontal plane, and pouring water into the bulb through the tubulature until it overflows the offtake. The amount remaining in the bulb shall be considered its capacity (Fig. 10).*

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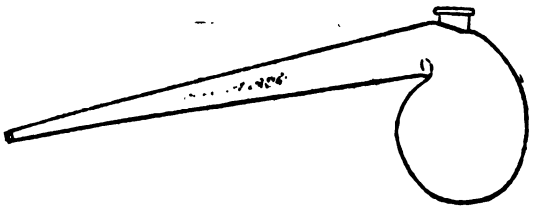

Fig. 10.

(B) *Condenser tube of any suitable form of glass tubing may be used; a convenient one is shown in Fig. 11.*

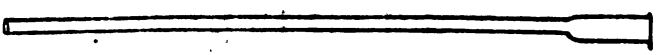

Fig. 11.

(C) *Shield of asbestos as shown in Fig. 12 shall be used to protect the retort from air currents, and to prevent radiation. This may*

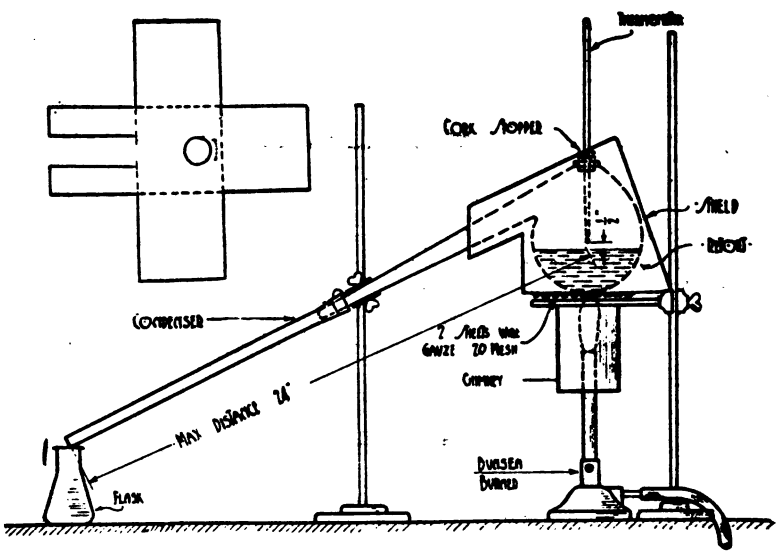


Fig. 12.

*be covered with galvanized iron, as such an arrangement is more convenient and more permanent.*

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(D) *Receivers (Erlenmeyer flask) of 50 to 100 c.c. capacity are most convenient form.*

(E) *Thermometer shall be made of resistance glass of a quality equivalent to suitable grades of Jena or Corning make. It shall be thoroughly annealed. It shall be filled above the mercury with inert gas which will not act chemically on or contaminate the mercury, The pressure of the gas shall be sufficient to prevent separation of the mercury column at all temperatures of the scale. There shall be a reservoir above the final graduation large enough so that the pressure will not become excessive at the highest temperature.*

*The thermometer shall be finished at the top with a small glass ring or button suitable for attaching a tag. Each thermometer shall have for identification the maker's name, a serial number and the letters "A. S. T. M. Distillation."*

*The thermometer shall be graduated from 0 to 400° C. at intervals of 1° C. Every fifth graduation shall be longer than the intermediate ones, and every tenth graduation beginning at zero shall be numbered. The graduation marks and numbers shall be clear cut and distinct.*

*The thermometer shall conform to the following dimensions:*

*Total length, m.m., 385 maximum.*

*Diameter of stem, m.m., 7, tolerance 0.5.*

*Diameter of bulb, m.m., 5 minimum, and shall not exceed that of the stem.*

*Length of bulb, m.m., 12.5, tolerance 2.5.*

*Distance 0° to bottom of bulb, 30, tolerance 5.*

*Distance 0° to 400° C., 295, tolerance 10.*

*The accuracy of the thermometer when delivered to the purchaser shall be such that when tested at full immersion the maximum error from 0° to 200° C. shall not exceed 0.5°; 200° to 300° C. it shall not exceed 1° C.; 300° to 375° C., it shall not exceed 1.5° C.*

*The sensitiveness of the thermometer shall be such that when taken at a temperature of 26° C., and plunged into free flow of steam, the meniscus shall pass the 90° C. mark in not more than six seconds.*

*The retort shall be supported on a tripod or rings over two sheets of 20-mesh gauze, 6 ins. square. It shall be connected to the condenser tube by a tight cork joint. The thermometer shall be inserted through a cork in the tubulature with the bottom of the bulb ½ in. from the surface of the oil in the retort. The exact location of the thermometer bulb shall be determined by placing a vertical rule graduated in divisions not exceeding 1/16 in. back of the retort when the latter is in position for the test, and sighting the level of the liquid and the point*

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*for the bottom of the thermometer bulb. The distance from the bulb of the thermometer to the outlet end of the condenser tube shall be not more than 24 nor less than 20 ins. The burner shall be protected from draughts by a suitable shield or chimney (Fig. 12.)*

METHOD.—*Exactly 100 grams of oil shall be weighed into the retorts, the apparatus assembled, and heat applied. The distillation shall be conducted at the rate of at least one drop and not more than two drops per second, and the distillate collected in weighed receivers. The condenser tube shall be warmed whenever necessary to prevent accumulation of solid distillates. Fractions shall be collected at the following points: 210°, 235°, 270°, 315°, and 355° C.*

*The receivers shall be changed as the mercury passes the dividing temperature for each fraction. When the temperature reaches 355°, the flame shall be removed from the retort, and any oil which has condensed in the offtake shall be drained in the 355° fraction.*

*The residue shall remain in the retort with the cork and the thermometer in position until no vapors are visible; it shall then be weighed and carefully poured directly into the brass collar for float-test (see Section 6), or into a tin box and covered and allowed to cool to air temperature.*

*If the residue becomes so cool that it cannot be poured readily from the retort, it shall be re-heated by holding the bulb of the retort in hot water or steam, and not by the application of flame. The float-test shall be made on this residue as described (Section 6.)*

*For weighing the receivers and fractions, a balance accurate to at least 0.05 g. shall be used.*

*During the progress of the distillation the thermometer shall remain in its original position. No correction shall be made for the emergent stem of the thermometer.*

*When any measurable amount of water is present in the distillate, it shall be separated as nearly as possible and reported separately, all results being calculated on a basis of dry oil. When more than 2% of water is present, water-free oil shall be obtained by separately distilling a larger quantity of oil, returning to the oil any oil carried over with the water, and using dried oil for final distillation. (See Section 1, Water.)*

### 5. Specific Gravity of Fractions.

As specific gravity is an absolute physical determination, any recognized method which can be applied to the quantity and quality of material at hand to be tested, must be considered satisfactory. The following methods are recommended by the Committee as convenient and accurate means for the relatively small amounts of oil available in determining gravity of fractions to be tested.

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**Liquid Fractions.**

APPARATUS.—*Westphal balance.*

METHOD.—*If the fraction to be tested is liquid at a temperature not exceeding 60° C., the Westphal balance can be used with convenience and rapidity. A special type of Westphal balance is obtainable, designed for testing very small quantities. However, the ordinary type Westphal balance can be adapted to testing small fractions by the use of a special plummet. This can readily be made in the laboratory from a piece of ordinary glass tubing 7 m.m. outside diameter, sealed at the end, and melting into the glass where sealed a short platinum wire.*

*After cooling place 9 to 10 grams of mercury in the tube, making a column 35 to 40 m.m. high. Seal off the tube within 20 m.m. of the top of the mercury column with blowpipe flame. The plummet should have a length of about 55 to 60 m.m. over all, and should weigh between 10 and 12 grams.*

**Solid and Semi-Solid Fractions.**

APPARATUS.—*Special platinum or nickel pan as shown in Figs. 13a and 13b.*

METHOD.—*For the determination of fractions that are solid or semi-solid and cannot readily be liquefied at a temperature not exceeding 60° C., a weighing pan constructed of platinum or nickel (Figs. 13a and 13b) may be used.*

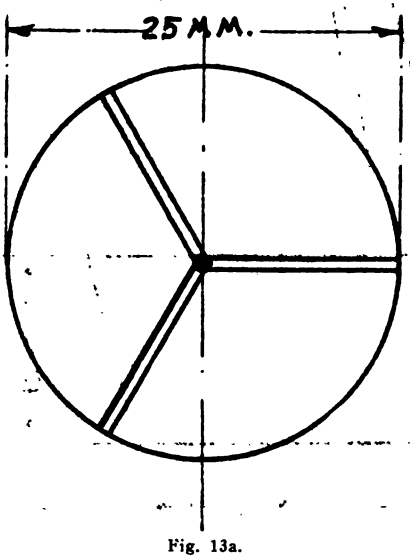


Fig. 13a.

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*A pan of convenient dimensions is 20 m.m. diameter at the base and 25 m.m. diameter at the top, and about 12 m.m. deep. It is made*

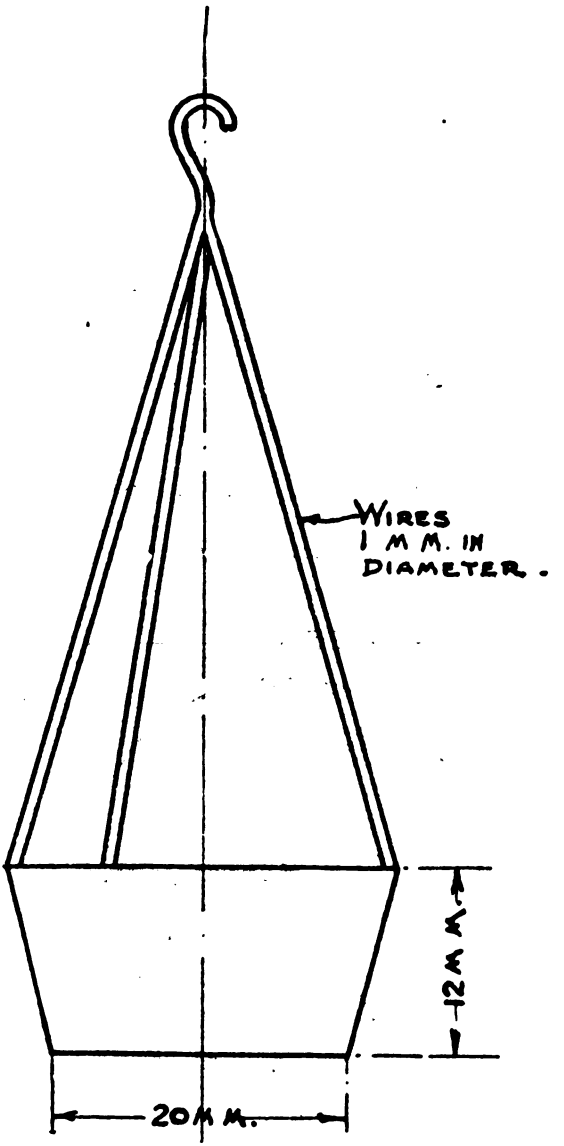


Fig. 13b.

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*of platinum and supported by three platinum wires 1 m.m. in diameter, and has a total weight of about 7 grams.*

*Solid or semi-solid fractions of oil can be rapidly and accurately tested in this apparatus by the usual method of weighing in air and in water. The usual precaution, of igniting the pan before use, avoiding the enclosure of air or water in the sample, should be observed.*

NOTE.—*The method for liquid fractions is usually applicable to the fractions 235 to 315° C. and the method for solid and semi-solid fractions to the fraction 315 to 355° C. In appendix are given examples of calculating the specific gravity of fractions at 38° C., compared with water at 15.5° C., by both of the foregoing methods.*

### 6. Float Test of Residue.

*The residue taken as heretofore described (Section 4) shall be tested for consistency by the float-test.*

APPARATUS.—*The float apparatus consists of two parts, an aluminum float or saucer and a conical brass collar (Fig. 14). The two parts are made separately, so that one float may be used with a number of brass collars.*

METHOD.—*In making the test, the brass collar is placed with the small end on the brass plate, which has been previously amalgamated with mercury by first rubbing it with a dilute solution of mercuric chloride or nitrate and then with mercury.*

*The residue to be tested is either poured into the collar direct from the retort, as described in Section 4, or heated in a tin box on water or*

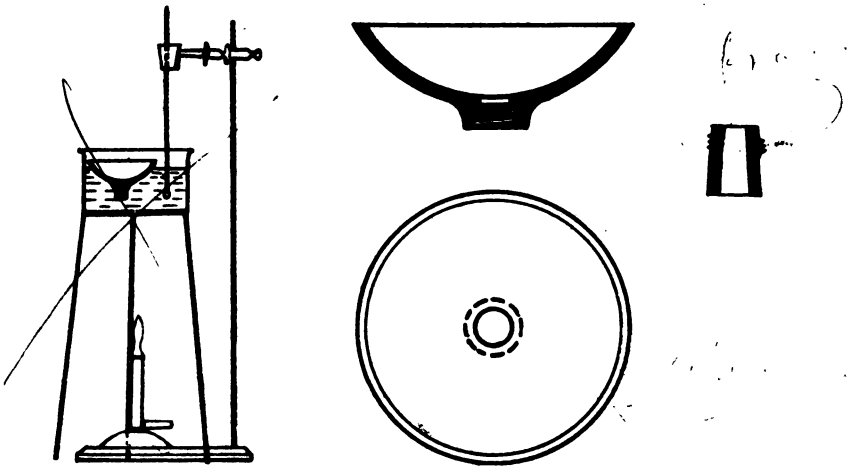

Fig. 14.

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*steam bath, not by direct application of flame, and then poured into the collar in any convenient way, until slightly more than level with the top. The surplus may be removed after the material has cooled to room temperature, by means of spatula or steel knife which has been slightly heated. The collar and plate are then placed in one of the tin cups containing ice water maintained at 5° C., and left in this bath for at least 15 minutes.*

*Meanwhile the other cup is filled about three-fourths full of water and placed on the tripod, and the water is heated to any desired temperature at which the test is to be made. This temperature should be accurately maintained, and should at no time throughout the entire test be allowed to vary more than one-half a degree Centigrade from the temperature selected.*

*After the material to be tested has been kept in the ice water for at least 15 minutes and not more than 30 minutes, the collar with its contents is removed from the plate and screwed into the aluminum float, which is then immediately floated in the warmed bath. As the plug of bituminous material becomes warm and fluid, it is forced upward and out of the collar, until the water gains entrance to the saucer and causes it to sink.*

*The time in seconds between placing the apparatus on the water and when the water breaks through the bitumen is determined by means of a stop watch, and is taken as a measure of the consistency of the material under examination.*

### 7. Coke Residue.

APPARATUS.—*Hard glass bulbs similar to the one shown in Fig, 15 are to be used.*

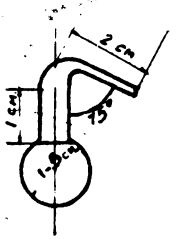


Fig. 15.

METHOD.—*Warm the bulb sligthly to drive off all moisture, cool in a desiccator, and weigh. Again heat the bulb by placing it momentarily in an open Bunsen flame and place the tubular underneath the surface of the oil to be tested and allow the bulb to cool until sufficient oil is sucked in to fill the bulb about two-thirds full.*

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*Any globules of oil sticking to the inside of the tubular should be drawn into the bulb by shaking or expelled by slightly heating it, and the outer surface should be carefully wiped off and the bulb re-weighed. This procedure will give about 1 gram of oil.*

*Cut a strip of thin asbestos paper about ¼ in. wide and about 1 in. long, place it around the neck of the bulb and catch the two free ends close up to the neck with a pair of crucible tongs. The oil should then be distilled off as in making ordinary oil distillation, starting with a very low flame and conducting the distillation as fast as can be maintained without spurting.*

*When oil ceases to come over, the heat should be increased until the highest temperature of the Bunsen flame is attained, the whole bulb being heated red hot until evolution of gas ceases, and any carbon sticking to the outside of the tubular is completely burned off. The bulb should then be cooled in a desiccator and weighed and the percentage of coke residue calculated to water-free oil.*

The Committee desires to present in support of the specifications recommended, the following:

**Creosote Oil for Ties and Structural Timber.**

This specification is based on the standard specification for creosote oil of the American Railway Engineering Assoc. (Manual, 1915, page 541). The Committee offers the following with reference to each change made in the substance of the American Railway Engineering Association's specification:

The definition of the oil has been changed from

> The oil shall be the best obtainable grade of coal-tar creosote, that is, it shall be a pure product obtained from coal tar, gas tar, or coke-oven tar.

to read:

> The oil shall be a distillate of coal-gas tar or coke-oven tar.

The Committee believes that the latter definition is more clear, and therefore, less liable to misinterpretation. The clause "shall be free from suspended matter" has been omitted, and a requirement limiting insoluble matter to 0.5% is substituted therefor. The term "free from suspended matter," if interpreted rigidly, would bar out practically any commercial oil, which always contains traces of suspended matter, and if not so intrepreted, it is meaningless. The proposed requirement is a definite one, which prevents any unreasonable amount of adventitious material.

The requirement that the oil shall be completely liquid at 38° C. has been omitted. In the Committee's opinion, any oil complying with these specifications is sufficiently liquid at high temperatures to insure ease of handling, and it is a matter of no importance whether it is entirely liquid at 38° C. or not.

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The requirement that the "residue above 355° C., if it exceeds 5%, shall be soft," has been changed to a definite requirement. In other words, we have provided a means of determining whether the residue is soft or not, a point which heretofore has always been left to individual judgment. This test is of more significance in connection with the specifications for creosote-coal tar solution and coal-tar paving oil, and will be discussed more fully under those specifications.

Additional requirements, not included in the American Railway Engineering Association specifications, are specific gravity of fractions and the coke residue test. The requirements on specific gravity of fractions have been included in various specifications for creosote oil during the past four or five years. They are included in this and in other specifications here presented, because the Committee finds that these tests, more than any others that have been proposed or made known to its members, tend to exclude the admixture of products from water-gas tar or other products of petroleum origin that might be added to the oil for the purpose of cheapening it. The Committee submits an appendix to this report, giving results of tests indicating the value of this requirement.

The coke residue test is added to this and to other specifications, because the Committee finds that this test, in connection with the other requirements, does effectively bar out or control the addition of refined or filtered tars, or pitches. In the appendix are given data showing the value of this test on distillate oils as well as on creosote-coal tar solution and paving oils. The test was first proposed and adopted by the National Electric Light Association in 1911, and at that time had the approval of a committee containing a number of the leading authorities on creosote specifications. Your Committee now approves it as a practical, and at the same time, reasonably effective test for the purpose indicated.

The standard specification of the American Railway Engineering Association for creosote oil has been so widely recognized that the Committee feels no explanation is necessary in retaining the main requirements of that specification, and all the modifications hitherto recited are merely for the purpose of strengthening and modernizing said specification.

Difficulty in obtaining this oil in sufficient quantity to meet the requirements of the railroads and other consumers, led to consideration and the recommendation by the American Railway Engineering Association in 1912 of specifications for No. 2 and No. 3 grade of creosote oil. These specifications provided for oils of lower distilling range

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than the standard.* However, the present tendency is not in favor of the use of lower boiling oils, and the widely used mixture of distillate oils and refined or filtered tar has more recently been recognized by the American Railway Engineering Association under the term "creosote-coal tar solution." The latter is now used not only by reason of expediency or economy, but by many who believe a moderate tar addition of advantage.

**Creosote-Coal Tar Solution for Ties.**

This specification is based on the specifications for creosote-coal tar solution appearing in the American Railway Engineering Association Manual, 1915, page 546. The following changes have been made:

In the definition, a specific limit has been placed on the permissible percentage of refined or filtered tar that the oil may contain. The minimum specific gravity of the oil has been raised from 1.03 to 1.05, as no oils meeting the other tests would be likely to fall under 1.05.

The specific viscosity test in the old specification has been omitted. The data in the Committee's hands show variations in this test that are difficult to explain, and indicate that many oils that are entirely satisfactory might be barred out. Hence, the test is omitted as one tending to complicate the specification, without adding anything of proven value.

The maximum distillate permitted up to 235° C. has been lowered from 30 to 25%, in order reasonably to restrict the specification against the use of low-boiling oils.

The additional requirements of this specification not appearing in the American Railway Engineering Association specification, are the same as the additional requirements heretofore described under the specification for creosote oil.

Supplementing the explanations heretofore presented, the Committee calls attention to the function of the consistency test on residue above 355° C., and the coke test, in relation to controlling the permissible addition of refined or filtered tars. The percentage of tar can be pretty definitely limited by requiring that the residue above 355° C. shall not exceed a specific amount, as was done in the old specification. This, however, as shown by example given in appendix, will bar even

*The specifications recommended by the Committee are for types of oil, and the limits specified for the various requirements are fixed in accordance with the best information obtainable and the Committee's judgment. However, it is obvious that any of these specifications can be slightly modified if desired, without departing from the general type of oil specified, or from the general lines laid down in the specification. For example, if an oil similar to the American Railway Engineering Association No. 2 is desired instead of No. 1 or standard oil, the maximum distillates permitted at 210° and 235° C. could be altered as desired and no other alteration in the specification for creosote oil for ties would be necessary.

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the permissible addition contemplated by the specification in the case of higher boiling creosote, thus working to the disadvantage of the consumer as well as the producer. On the other hand, by requiring that the residue, if it exceeds a specific limit, shall have a definite softness, the integrity of the specification as to tar addition is maintained without prejudice to the use of high-boiling oils.

Reference to the appendix shows the value of the coke test as an additional check on the tar content of the oil. The analyses from which the maximum limit for the coke test in this and the other specifications was determined, were made in the laboratories of individual members of the Committee. In view of the comparatively recent origin of this test, additional data from members outside the Committee is desired, so that the limits can, at some later time, perhaps be made more restrictive. Meanwhile, the Committee feels safe in presenting the figures selected.

**Coal Tar Oil for Paving Blocks.**

This is substantially in accordance with a recommendation made to this Association a year ago by the special committee appointed for that purpose. This Committee finds, however, that the specification heretofore presented failed to meet with universal approval, for the reason that an attempt was made to permit within one specification a creosote-coal tar solution or a distillate creosote. This made necessary wider limits for specific gravity, distillation, etc., than seemed consistent to some. Other objections offered to the specification were that its requirements did not prevent adulteration with water-gas-tar products, and that the coal tar addition was not definitely controlled.

In the specification here presented, these objections are met by providing a separate specification for a distillate oil for paving blocks. The coal tar oil for paving blocks specification, like that for the creosote-coal tar solution for ties, defines specifically the permissible percentage of refined or filtered tars. In all the requirements of the specification it parallels closely the preceding specification, so that a detailed discussion of each separate requirement seems unnecessary. Reference to the appendix gives specific illustrations showing the applicability of the consistency test of the resdiue above 355° C., the specific gravity of fractions, and the coke residue, to this specification.

The specification for coal tar oil for paving blocks and the specification for distillate oil for paving blocks as then developed by this Committee, were submitted in September, 1916, at a joint conference meeting of the committees representing this Association, the American Society for Testing Materials, the American Society of Municipal Improvements, the American Society of Civil Engineers and the Southern

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Pine Association, and unanimously accepted by that meeting. In October, these specifications were adopted as standard by the American Society of Municipal Improvements at its annual meeting in Newark. Since then, the Committee has found that the specifications are strengthened by requiring higher specific gravities for certain fractions of the oil. Consequently, in the specifications now proposed, the specific gravity of the fraction 235 to 315° C. must be 1.03 and of the fraction 315 to 355° C., 1.10, instead of 1.02 and 1.09, respectively, as in the specifications adopted by the American Society of Municipal Improvements.

The Committee desires to state frankly that the tests provided by these specifications do not absolutely prevent addition of water-gas-tar products, provided the definition is disregarded by the manufacturers of the oil; but the proportion of such products that could be added without detection is so limited that it is not likely to be attempted. Your Committee is of the opinion that creosote oil, considering its low price in the commodity scale, is subjected by the tests required in these specifications to a greater rigidity of examination than the majority of higher-priced products.

The Committee wishes to state its belief that if an oil containing any considerable amount of water-gas-tar products be subjected to the test under these specifications, there will be sufficient indications to arouse the suspicions of an experienced inspector. The oils can then be subjected to a more rigid chemical examination, using tests which it is not practical to embody in a general specification.

**Distillate Oil for Paving Blocks.**

This specification follows exactly the same lines as the specification for creosote oil for ties and timbers, hence a discussion of each separate requirement is unnecessary. The specification, on the face of it, provides for high-boiling creosote oil, and is equally restricted as the preceding specifications against adulteration or tar addition. Your Committee believes that authorities are almost in accord in the belief that low-boiling oils are not well adapted to paving block requirements. The present specification provides an oil which can be commercially obtained without difficulty, and will meet the demands of those who do not approve of the use of the coal tar paving oil.

In presenting these four specifications, the Committee desires to be clearly understood as to the objects and purpose of its work. It has sought to clarify, improve and safeguard existing standards, rather than to develop new ones. It holds no brief for or against any type or grade of oil. The Committee's purpose has been accomplished, if, by reason of the adoption of these specifications, it becomes easier for the engineer to select that type of oil he desires, for the distiller to produce it, and for the inspector or analyst to determine that the specifications have been fulfilled.

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## REPORT OF SUB-COMMITTEE C.

Instructions to this Sub-Committee were as follows:

Present for adoption:

Specifications for zinc chloride for general use:
Methods for sampling and testing.

Recommended for adoption by the Association.

### Specification for Zinc Chloride.

*The zinc chloride shall be free from acid and shall not contain more than 0.5% iron. It shall be furnished in solid (fused) state or in concentrated solution (usually 50%). The zinc chloride shall be furnished on the basis of the percentage of pure (100%) zinc chloride present.*

The percentage iron content allowable in the specification was given thoughtful consideration by the Committee. They corresponded with several large zinc manufacturers regarding this subject. The conclusion arrived at by the Committee was that 0.5% of iron was a fair figure. If the percentage of iron allowable is made smaller than this, it tends to increase the cost of the zinc without commensurate advantage; if the percentage allowable is placed much higher than this figure, it permits of the manufacture of zinc chloride from low-grade raw materials.

### Method of Analysis for Zinc Chloride.

The Association adopted a method for the analysis of zinc chloride in January, 1912. This was printed in the 1912 PROCEEDINGS, page 230 and reprinted in the 1915 PROCEEDINGS, page 131. As this method has proved satisfactory, the Committee decided it was not necessary at this time to suggest any revision.

### Sampling Solid Zinc Chloride.

The question of sampling of solid zinc chloride for test purposes was considered by the Sub-Committee, but as no satisfactory method could be arrived at it was decided to recommend that this problem be included in the work outlined for next year's Committee on Preservatives.

## REPORT OF SUB-COMMITTEE D.

The instructions to your Sub-Committee were as follows:

To present all the information available concerning the use of water-gas tar and oil for treating paving blocks, and, if in the judgment of the Committee it is warranted, a tentative specification for such oil.

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In accordance with these instructions, your Sub-Committee begs to report as follows:

It was found upon investigation that there are in existence many thousands of square yards of wood-paving that, judging from the chemical analysis of the original oil now in the blocks, had been originally treated either wholly, or in greater part with water-gas tar. In view, however, of the specifications and other conditions connected with the treatment and laying of many of these blocks, it did not seem advisable to include them in this report.

We have, however, submitted for your consideration the location, yardage, character of treatment, oil used, present condition, traffic conditions, and in some cases a photograph of a considerable number of streets that are paved with wood blocks that were treated with refined water-gas tar.

With the exception of two cases which are noted, your Sub-Committee by its personal knowledge is assured that the oil used was refined water-gas tar of the grade represented by the analysis and that the quantity injected per cubic foot was found from the block manufacturers' records to agree with the specifications. (Exhibit "A" to "L.")

The streets and locations listed in Tables I to V were inspected by your Sub-Committee during the spring and summer of 1916. These streets were found to be in the condition as noted in the tabulation. Where the condition of the pavement is not noted, it is because your Sub-Committee was unable to make a personal inspection of the paving, but they in all such cases made inquiries by letter and otherwise, and have been assured that the present condition of these uninspected streets is entirely satisfactory.

In passing judgment on the serviceability of a material for use in treating paving blocks, your Sub-Committee feels that there are four features to be considered:

(1). Water-proofing value of the material.
(2). Its preservative value as against decay.
(3). Permanency of the oil in the blocks.
(4). Ease and completeness of penetration.
(5). Its freedom from bleeding.

The water-proofing value of water-gas tar has been quite generally recognized, and a number of references in the literature and in the PROCEEDINGS of this Association are to be found bearing on this point. In addition, your Sub-Committee submits the results of the laboratory tests to determine this property that were made at the treating plant of blocks laid on the streets inspected. These are given in Table VI. It will be noted that these results indicate a uniformly high water-proofing value.

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As regards the preservative value of the material against decay, your Sub-Committee would report that it was unable to find any instance of decay in any of the blocks inspected by it, nor was any such decay reported from any of the uninspected work. Since a number of these streets have been in service for over eight years, your Sub-Committee feels justified in assuming that this feature of the requirements of a proper preservative has been amply fulfilled.

As regards the permanency of the oil in the blocks, your Sub-Committee submits in Tables VII and VIII, the analyses of the oil extracted from blocks from two streets that had been in service for eight years. An examination of the distillation of the recovered oil as compared with the original oil indicates that no material change has taken place after eight years' exposure.

The members of the Committee who were present at the inspection of the Sixth Avenue Bridge, at Pittsburgh, will recall the completeness with which the blocks were impregnated. This has been found to be characteristic of blocks that were inspected over a large number of locations, and is excellent evidence of the ease and thoroughness with which the preservative prepared from water-gas tar permeates the wood.

With regard to bleeding, your Sub-Committee would call particular attention to the fact that, from its inspections, and from the inquiries it made of those having the pavements in charge, there was an entire absence of any complaint from bleeding, not only as to the older pavements, but also on those of very recent construction.

Your Sub-Committee is convinced, therefore, that as a result of the fulfillment of the foregoing requirements, and in view of the uniformly successful results that were obtained, as evidenced by the examples cited in this report, the refined water-gas tar has demonstrated its value and usefulness as a preservative for wood-paving block.

It, therefore, recommends to the Committee that refined water-gas tar be recognized as a suitable and satisfactory wood-block preservative, and that the following specifications be submitted to the Association for adoption, as a standard specification for this class of material:

## REFINED WATER-GAS TAR FOR PAVING BLOCKS.

*The preservative shall be a refined water-gas tar. It shall comply with the following requirements:*

1. *It shall contain not more than 3% of water.*
2. *It shall contain not more than 2% of matter insoluble in benzol and chloroform.*
3. *The specific gravity of the preservative at 38° compared with water at 15.5° C. shall not be less than 1.110, nor more than 1.140.*

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TABLE I.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

| Year and City in Which Blocks were Laid. | Location of Blocks. | Square Yards (Approximate.) | Absorption per Cubic Foot of Lumber. | Analysis. | Photograph. | Traffic. | Condition. | Specification. |
|---|---|---|---|---|---|---|---|---|
| **1908.** Boston, Mass. | Washington St. from 78' South of Court Ave. to Cornhill and State Sts. N. & S. of Old State House. | 1300 | 20 lbs. | (A); | 1 | Heavy<br>Heavy<br>Heavy | Good<br>Fair<br>Fair | I<br>I<br>I |
| Pittsburgh, Pa. | 6th St. Bridge Between Pittsburgh and Allegheny. | 3228 | 20 lbs. | | 2 | Heavy | Good | E |
| Havana, Cuba. | Shop Flooring. | 4800 | 20 lbs. | | | | | E |
| New York, N. Y. | Rogers Place from Dongan to 165th St. | 2975 | 20 lbs. | | | Light | Good | H |
| New York, N. Y. | Minford St., Boston Road to Jennings. | 4541 | 20 lbs. | | | Light | Good | H |
| New York, N. Y. | Charlotte St., Boston Road to Jennings. | 3644 | 20 lbs. | | 3 | Light | Good | H |
| New York, N. Y. | Liberty Street Terminal. | 1260 | 20 lbs. | | | Heavy | Good | E |
| Waterbury, Conn. | Intersection of West Main and Willow St. | | 20 lbs. | | | Heavy | Good | E |
| **1909.** Boston, Mass. | Bowdin St. | 1583 | 20 lbs. | (B) | | Light | Good | I |
| Boston, Mass. | Falmouth St. | 1435 | 20 lbs. | | | Light | Good | I |
| Holyoke, Mass. | ..... | 1868 | 20 lbs. | | | Light | Good | E |
| Oakmont, Pa. | Bridge Floor | 3915 | 16 lbs. | | 4 | Light | Good | E |

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TABLE II.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

| Year and City in Which Blocks were Laid. | Location of Blocks. | Square Yards (Approximate.) | Absorption per Cubic Foot of Lumber. | Analysis. | Photo-graph. | Traffic. | Condi-tion. | Speci-fica-tion. |
|---|---|---|---|---|---|---|---|---|
| **1910.** | | | | (C) | | | | |
| Asbury Park, N. J. | Flooring for Bridge at Deal Lake. | 2038 | 16 lbs. | | | Heavy | Good | B |
| South Boston, Mass. | Milk St., Pearl to Oliver St. | 2353 | 20 lbs. | | | Heavy | Good | I |
| | Pearl St., Milk St. to 148' North. | | | | | Heavy | Good | I |
| | Oliver St., Milk St. to 200' Southeast. | | | | | Heavy | Good | I |
| Philadelphia, Pa. | Flooring Pier 34 South Wharves. | 4860 | 16 lbs. | | | Heavy | Fair | B |
| Eddystone, Pa. | Baldwin Locomotive Works Machine Shop Flooring. | 7137 | 16 lbs. | | | | | B |
| **1911.** | | | | (D & E) | | | | |
| Newark, N. J. | Plank Road Bridge over Passaic River. | 2562 | 20 lbs. | | | Heavy | Good | E |
| Bridgeport, Conn. | State St., Broad St. to Fairfield Ave. | 24433 | 16 lbs. | | | Heavy | Good | L |
| Boston, Mass. | Milk St., Oliver to Broad St. | 1096 | 20 lbs. | | | Heavy | Good | I |
| Boston, Mass. | Washington St., Williams to Dudley St. | 4300 | 20 lbs. | | 5 | Heavy | Good | I |

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TABLE III.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

| Year and City in Which Blocks were Laid. | Location of Blocks. | Square Yards (Approximate.) | Absorption per Cubic Foot of Lumber. | Analysis. | Photograph. | Traffic. | Condition. | Specification. |
|---|---|---|---|---|---|---|---|---|
| **1911.** | | | | (D & E) | | | | |
| Boston, Mass. | Ferdinand St., Fayette St. to B. & A. R. R. | | | | | Medium | Good | I |
| | Fayette St., Ferdinand to Pleasant St., Melrose St., Ferdinand to Pleasant St., Church St., Melrose to Fayette St. | 5230 | 20 lbs. | | | Light | Good | I |
| **1912.** | | | | (F & G) | | | | |
| Cambridge, Mass. | Mass. St., Brattle Sq. to Bigelow. | 27514 | 20 lbs. | | | Heavy | Good | C |
| | Harvard Sq., Brattle Sq. to Subway Entrance Including Mount Auburn St. | | | | | Heavy | Good | C |
| | Brattle Sq., Lafayette to Mass. | | | | | Heavy | Good | C |
| Philadelphia, Pa. | 33 St., Race to Powelton Ave. | 2928 | 18 lbs. | | | Light | Good | F |
| | 48 St., Woodland Ave. to Gray's Ferry Road. | | | | | Moderate | Good | F |
| | Woodland Ave., 48 St. to P. & W. C. R. R. | | | | | Light | Good | F |
| Philadelphia, Pa. | Wallace St., 18th to 19th Sts. | 3683 | 18 lbs. | | | Light | Good | F |
| | Hamilton St., 18th to 19th Sts. | | | | | Moderate | Good | F |
| | Hamilton St., 20th to 21st Sts. | | | | | Moderate | Good | F |

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TABLE IV.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

| Year and City in Which Blocks were Laid. | Location of Blocks. | Square Yards (Approximate.) | Absorption per Cubic Foot of Lumber. | Analysis. | Photo-graph. | Traffic. | Condi-tion. | Speci-fica-tion. |
|---|---|---|---|---|---|---|---|---|
| **1912.** | | | | (F & G) | | | | |
| East Cambridge, Mass. | Harvard Bridge | 9509 | 20 lbs. | | 6 | Heavy | Fair | I |
| New York City | 2nd Ave., 18th to 19th Sts. | | 16 lbs. | | | Heavy | Good | M |
| | 2nd Ave., 14th to 15th Sts. | | 20 lbs. | | | Heavy | Good | M |
| | North from 14th St. E. Side. | | | | | | | |
| | 2nd Ave., South of 7th St. | | 20 lbs. | | | Heavy | Good | M |
| Philadelphia, Pa. | Arch St., Front to 21st St. | 40000 | 18 lbs. | | | Heavy | Good | F |
| **1913.** | | | | (H) | | | | |
| Waterbury, Conn. | Bank St. | 2030 | 20 lbs. | | | Heavy | Good | I |
| Dorchester, Mass. | Washington St., Blue Hill Ave. to Talbet Ave. | 10130 | 20 lbs. | | | Moderate | Good | I |
| New Britain, Conn. | West Main St. | 7300 | 20 lbs. | | | Moderate | Good | E |
| Pittsfield, Mass. | Columbus Ave. | 4000 | 20 lbs. | | | Moderate | Good | D |
| **1914.** | | | | (I) | | | | |
| Fitchburg, Mass. | Main St., Pritchard to Railstone St. | 4000 | 20 lbs. | | | | | K |
| | Pritchard St., Main to Pleasant St. | | | | | | | K |
| | Railstone St., Main to Bridge St. | | | | | | | K |
| | Water St., 4th to 7th St. | | | | | | | K |

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TABLE V.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

| Year and City in Which Blocks were Laid. | Location of Blocks. | Square Yards (Approximate.) | Absorption per Cubic Foot of Lumber. | Analysis. | Photo-graph. | Traffic. | Condi-tion. | Specifi-cation. |
|---|---|---|---|---|---|---|---|---|
| **1911.** Ansonia, Conn. | Main St., Bridge St. to Brass Factory. | 9627 | 20 lbs. | (1) | | Heavy | Good | J |
| Meriden, Conn. | No. Colony St., Steam R. R. to 20 North of Wilcox Ave. | 3000 | 18 lbs. | | | | | J |
| Jersey City, N. J. | Washington St., Montgomery to Grand St. | 1190 | 20 lbs. | | | | | G |
| Philadelphia, Pa. | Locust St., Broad to 13th St. | 1550 | 18 lbs. | | | Moderate | Good | A |
| Philadelphia, Pa. | Fifth St., Girard Ave. to 433' Southward. | 1695 | 18 lbs. | | | Moderate | Good | A |
| Philadelphia, Pa. | 11th St., Market to Chestnut St. | 1410 | 18 lbs. | | | Heavy | Good | A |
| Philadelphia, Pa. | 10th St., Market to Chestnut St. | 1407 | 18 lbs. | | | Heavy | Good | A |
| Philadelphia, Pa. | 9th St., Market to Chestnut St. | 1363 | 18 lbs. | | | Heavy | Good | A |
| Jersey City, N. J. | York St., Van Verst to 255' East on Washington St. | 4620 | 20 lbs. | | | | | G |

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TABLE VI.—WATER ABSORPTION TESTS ON WOOD-PAVING BLOCKS TREATED WITH WATER-GAS TAR.

| Year | City | Absorption.—Per Cent. | | | | |
|---|---|---|---|---|---|---|
| | | No. of Samples. | Average. | Mean. | High. | Low. |
| 1908 | Pittsburgh, Pa. | 9 | 2.38 | 2.68 | 3.57 | 1.78 |
| 1909 | Oakmont, Pa. | 5 | 4.00 | 4.50 | 6.40 | 2.60 |
| 1911 | Bridgeport, Conn. | 147 | 3.12 | 3.42 | 5.74 | 1.09 |
| 1911 | Boston, Mass. | 72 | 2.85 | 3.16 | 5.06 | 1.26 |
| 1911 | Boston, Mass. | 15 | 3.73 | 4.04 | 5.45 | 2.64 |
| 1911 | Plank Road Bridge | 2 | 0.44 | 0.44 | 0.43 | 0.45 |
| 1912 | Cambridge, Mass. | 96 | 2.18 | 2.54 | 4.08 | 1.01 |
| 1912 | Philadelphia, Pa. | 42 | 2.17 | 2.64 | 4.21 | 1.07 |
| 1912 | Harvard Bridge | 62 | 3.11 | 3.70 | 6.40 | 1.00 |
| 1913 | Waterbury, Conn. | 40 | 2.85 | 3.85 | 6.46 | 1.24 |
| 1913 | Dorchester, Mass. | 30 | 2.85 | 3.28 | 4.98 | 1.58 |
| 1913 | New Britain, Conn. | 40 | 2.67 | 3.19 | 5.25 | 1.13 |
| 1913 | Pittsfield, Mass. | 20 | 2.45 | 2.42 | 3.02 | 1.83 |

Absorption test, 24 hours at 100° F., 24 hours in water at room temperature.

TABLE VII.—PRESERVATIVE EXTRACTED FROM WOOD BLOCKS TAKEN FROM SIXTH STREET BRIDGE BETWEEN PITTSBURGH, PA., AND ALLEGHENY, PA.

SPECIFICATION SCHEDULE "E."

| | | | Stock in 1908 | Specification Schedule "E." |
|---|---|---|---|---|
| Specific Gravity at 38° C. | 1.103 | | | 1.10-1.14 |
| Distillation, Bulletin No. 65 Method. | | | | |
| Up to 170° C. | Trace | | | Up to 150° C. |
| 170-225° C. | 9.6 | | | 0.5% |
| 225-255° C. | 3.8 | | | |
| 255-270° C. | 2.7 | | | |
| 270-315° C. | 13.4 | 29.5 | 32.3% | 20-40% |
| 315-360° C. | 23.0 | 70.5 | 67.7% | |
| Above 360° C. | 47.5 | | | |
| Water | | | | 3% |
| Insoluble in Benzol and Chloroform | | | | 3.5% |

TABLE VIII.—PRESERVATIVE EXTRACTED FROM WOOD BLOCKS TAKEN FROM INTERSECTION OF STATE ST.,—BROAD ST. TO FAIRFIELD AVE., BRIDGEPORT, CONN.

SPECIFICATION SCHEDULE "L."

| | | | Stock in 1908 | Specification Schedule "L." |
|---|---|---|---|---|
| Specific Gravity at 38° C. | 1.103 | | | |
| Distillation, Bulletin No. 65 Method. | | | | |
| Up to 170° C. | Trace | | | No requirements. |
| 170-225° C. | 7.5% | | | |
| 225-255° C. | 3.7 | | | |
| 255-270° C. | 1.9 | | | |
| 270-315° C. | 14.6 | 27.7 | 32.3% | |
| 315-360° C. | 19.0 | 72.3 | 67.7% | |
| Above 360° C. | 53.3 | | | |

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TABLE IX.—REFINED WATER-GAS TAR.

ROUTINE ANALYSIS OF STOCK TANKS.

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1908 | 1909 | 1910 | 1911 | 1911 | 1912 | 1912 | 1913 | 1914 | 1915 |
| Water | Trace | None | None | None | None | None | Trace | Trace | .6% | Trace |
| Specific Gravity at 77° F. | 1.13 | 1.125 | 1.12 | 1.111 | 1.117 | 1.131 | 1.12 | 1.11 | 1.125 | 1.1359 |
| Insoluble $CS_2$ | 0.9% | 0.2% | 0.6% | ..... | 0.8% | 0.8% | 1.3% | 0.5% | 1.0% | 1.7% |
| Solid Naphthaline | Trace | 0.2% | Trace | Trace | Trace | Trace | Trace | Trace | Trace | Trace |
| DISTILLATION | | | | | | | | | | |
| To 170° C. | Trace | None | 0.5% | 3.2% | None | None | None | 0.2% | 0.39% | None |
| To 315° C. | 32.3% | 27.4% | 27.1% | 18.7% | 23.9% | 21.0% | 27.0% | 33.8% | 26.19% | 26.05% |
| To 315° C. + | 67.7 | 72.6 | 72.4 | 78.1 | 76.1 | 79.0 | 73.0 | 66.0 | 73.42 | 73.95 |
| Residue | Hard | Hard | Hard | Hard | Hard | Hard | Hard | Hard | Hard | Hard |
| DISTILLATE | | | | | | | | | | |
| Sp. Gravity at 60° C., Fraction 255-315° C. | | 1.00 | 1.00 | ..... | ..... | ..... | 0.995 | ..... | 1.01 | ..... |
| Total Distillate Insoluble in Ethyl sulphate | | None | None | None | None | None | None | None | None | None |

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TABLE X.—REFINED WATER-GAS TAR.

| | | | |
|---|---|---|---|
| Specific Gravity 38°/15.5° C..... | 1.1100 | 1.1310 | 1.1400 |
| Insoluble in Benzol & Chloroform..... | 0.90% | 0.90% | 0.58% |
| Distillation: | | | |
| 210° C..... | 2.4 | Trace | Trace |
| 235° C..... | 9.8 | 2.2 | 1.6 |
| 315° C..... | 31.4 | 28.8 | 25.3 |
| 355° C..... | 47.0 | 43.7 | 38.5 |
| Specific Gravity of entire distillate 38°/15.5° C..... | 0.9950 | 1.0050 | 1.0130 |

EFFECT OF ADDITION OF PETROLEUM OILS TO REFINED WATER-GAS TAR.

| | Original Oil | +5% | +10% | Original Oil | +5% | +10% |
|---|---|---|---|---|---|---|
| Specific Gravity 38°/15.5° C..... | 1.1108 | 1.0890 | 1.078 | 1.131 | 1.102 | 1.090 |
| Insoluble in Benzol and Chloroform.... | 0.85 | ..... | ..... | 0.90 | ..... | ..... |
| Distillation: | | | | | | |
| 210° C..... | Trace | Trace | 0.0 | Trace | 0.0 | 0.0 |
| 235° C..... | 3.2 | 0.7 | 1.0 | 2.2 | 2.5 | 3.0 |
| 315° C..... | 20.2 | 23.6 | 25.2 | 28.2 | 29.9 | 30.6 |
| 355° C..... | 41.3 | 45.0 | 46.7 | 43.7 | 46.1 | 46.7 |
| Specific Gravity of Entire Distillate 38° 15.5° C..... | 0.9952 | 0.9800 | 0.9690 | 1.005 | 0.9890 | 0.980 |

*4. The distillates, based on water free oil, shall be within the following limits:*

*Up to 210° C., not more than 5%*
*Up to 235° C., not more than 15%*
*Up to 315° C., not more than 40%*
*Up to 355° C., not less than 25%*

*5. The specific gravity of the total distillate below 355° C., shall be not less than 0.99, nor more than 1.02 at 38° compared with water at 15.5° C.*

*6. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.*

This specification is one that has been in use for eight years, and covers the preservative that was used in the treatment of the blocks described in this report.

Table IX shows the average analysis of the stock tanks which cover the oil during the various years in the treatment of the blocks inspected.

This specification is essentially the same as that submitted to the American Society for Municipal Improvements, but it has been changed in its wording to make it uniform with those reported by the other Sub-Committee for adoption.

Your Sub-Committee has attempted, in drawing up this specification, to secure by definition and by requirements a refined water-gas tar. It believes that the gravity of the distillate specified would exclude the presence of any considerable quantity of petroleum oils.

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Your Sub-Committee submits, in Table X; analyses showing the character of refined water-gas tar that would probably be met with under this specification, and also analyses showing the effect of the addition of certain percentages of petroleum oils on the gravity of the distillate.

If the General Committee deems it advisable, the members of your Sub-Committee would be glad, either acting alone or in cooperation, to continue this work and present further data regarding the use of water-gas tar either wholly or in part of the treatment of wood block for paving purposes.

## Exhibit "A."

SPECIFICATION "A." The preservative shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations, and shall contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

*a.* SPECIFIC GRAVITY. The specific gravity shall be not less than 1.08 nor more than 1.14 at a temperature of 38° C.

*b.* SOLUBILITY. Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

*c. Distillate.* On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillates based on water-free oil, shall not exceed ½% at 150° C., and shall be not less than 30% nor more than 40% at 315° C. The specified distillation test requires the use of a glass retort of approximately 8 ozs. capacity, connected with a tube and bottle placed a maximum distance of 24 ins. from the center of the retort. A mercury thermometer in the retort shall be placed ½ in. above the oil, which shall be exactly 100 grains in quantity. The distillation shall be continuous and should be completed in about 45 minutes.

*d.* CONTAINED WATER. The preservative shall contain not more than 3% of water.

## Exhibit "B."

CHARACTER OF OIL. The oil with which the blocks are to be treated shall be a stable antiseptic and water-proofing oil, from which the water has been removed by distillation, and which shall have a specific gravity of not less than 1.12 at 38° C.

When distilled in the manner hereinafter described, the oil shall lose not more than 35% up to a temperature of 315° C. The distillate between 255° and 315° C. shall have a specific gravity of not less than 1.00, the said specific gravity being taken at a temperature of 60° C.

METHOD OF TESTING OIL. One hundred grams of oil are weighed out into a glass retort, preferably made of Jena glass, having a capacity to bend of neck of 250 c.c. A condensing tube, air-cooled, is attached to the retort of such length that the total distance from the tubulure to the end of the condensing tube shall be approximately 60 c.m. The tubulure is fitted with a cork through which a nitrogen filled thermometer, registering to 400° C. and about 40 c.m. in length, is inserted in such a manner that the bottom of the bulb shall be ½ in. above the liquid at the time the distillation commences.

The distillation is made in a place free from draughts, and the retort is covered with asbestos paper and heated by the direct flame of an adjustable burner. The oil is warmed cautiously until any water that may be present is expelled. If water is present the amount is reported separately, all results being calculated on a dry-oil basis. The flame is then regulated in such a manner that the rate of distillation shall continuously be not slower than one dron per second, and not faster than two drops per second. The distillates are collected in weighed Erlenmeyer flasks.

The specific gravity of the fraction boiling from 255° to 315° C. is determined by means of a specific gravity bottle having a capacity of about 10 c.c. The oil previously warmed is poured into the bottle, which is then placed in a thermostat kept at 60° C. for one-half hour. The stopper is then inserted, the excess of oil

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No. 1.—Washington St., from 78 Ft. south of Court Ave. to Cornhill and State Sts., Boston, Mass.
(Laid in 1908. Photographed Sept., 1916.)

wiped off, and after cooling the weight is obtained. This weight is compared with the weight of water at 60° C. which the same bottle contains.

INSPECTION AT THE WORKS. During the progress of manufacture and treatment of the paving blocks, the purchaser may designate—and maintain at his own expense—a representative who shall at all such times have full facilities afforded him by the manufacturer to inspect the timber, materials and methods used in the manufacture and treatment of the blocks.

## Exhibit "C."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 48° F. When distilled in a retort, with the thermometer suspended not less than 1 in. above the oil, it is to lose not more than 35% up to 315° C. The oil is to be free from any adulteration; it is not to be mixed or contain any foreign material.

## Exhibit "D."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 38° C. The oil is to contain not more than 5% of matter insoluble by continuous hot extraction with benzol and chloroform. The oil is to yield not more than 1% of distillate below 150° C. nor more than 25% below 315° C. when distilled in accordance with the method described in Bulletin No. 65 of the American Railway Engineering Association. The oil is to be free from petroleum or asphaltic residues.

## Exhibit "E."

PRESERVATIVE. The preservative used shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

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The specific gravity shall be not less than 1.10 nor more than 1.14 at a temperature of 38° C.

Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillate, based on water-free oil shall not exceed ½% at 150° C., and shall be not less than 20% nor more than 40% at 315° C.

The oil shall contain not more than 3% of water.

The manufacturer of the blocks shall permit full and complete sampling at all times and places, and shall, if required, furnish satisfactory proof of the origin of the preservative.

Samples of the preservative, taken from the treating tank during treatment, shall at no time show an accumulation of more than 2% of sawdust, dirt, or foreign matter. Due allowance shall be made for such accumulation of foreign matter by injecting an additional quantity of oil into the blocks.

## Exhibit "F."

The preservative to be used shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

*a.* The specific gravity shall be not less than 1.10 nor more than 1.14 at a temperature of 38° C.

*b.* Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

No. 2.—Sixth St. Bridge Between Pittsburgh and Allegheny, Pittsburgh, Pa. (Laid in 1908. Photographed Nov., 1916.)

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No. 3.—Charlotte St., Boston Road to Jennings, New York, N. Y.
(Laid in 1908. Photographed Oct., 1916.)

*c.* On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillate, based on water-free oil, shall not exceed 1½% at 150° C., and shall be not less than 30% nor more than 40% at 315° C.

*d.* The oil shall contain not more than 3% of water.

## Exhibit "G."

The creosote oil is to conform to the following specifications when tested, as follows:

1. The specific gravity of the oil shall be at least 1.03 and not more than 1.10 at 38° C.

2. It shall be completely liquid at 25° C., and show no deposit on cooling at 22° C.

3. The oil shall be a pure coal-tar product or in the proportion of one-half water-gas tar, free from any adulteration; any petroleum oil or any product obtained from petroleum, and shall not contain more than 5% of matter insoluble in benzol.

The oil shall be subject to a distilling test as follows:

The apparatus for distilling the creosote must consist of a stoppered glass retort having a capacity, as nearly as can be obtained, of 8 ozs. up to the bend of the neck, when the bottom of the retort and the mouth of the offtake are in the same plane. The bulb of the thermometer shall be placed ½ in. above the liquid in the retort, and this position must be maintained throughout the operation. The bulb of the retort and at least 2 ins. of the neck must be and remain covered with a shield of heavy asbestos paper during the entire process of distillation, so as to prevent heat radiation, and between the bottom of the retort and the flame of the lamp or burner two sheets of wire gauze, each 20-mesh fine and at least 6 ins. square, must be placed. The flame must be protected against air currents.

Before beginning the distillation, 100 grams of the oil shall be placed in the retort. The thermometer shall be inserted in the retort, with the lower end of the

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bulb ½ in. from the surface of the oil, and the condensing tube attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube shall be 22 ins., and during the process of the distillation the tube may be heated to prevent the congealing of the distillates.

The distillates shall be collected in weighed bottles, and all percentages determined by weight in comparison with dry oil. The distillation shall be continuous and uniform, the heat being applied gradually, and shall take from 30 to 40 minutes after the first drop of distillate passes into the receiving vessel.

The total amount of distillate shall not exceed the following:

Up to 150° C., nothing must come off.
Up to 210° C., not more than 10% must come off.
Up to 235° C., not more than 35% must come off.
Up to 315° C., not more than 75% must come off.

## Exhibit "H."

NEW YORK, BOROUGH OF BRONX, 1908.

TREATMENT. The blocks shall be treated as hereinafter specified with an antiseptic and water-proof mixture, substantially 75% of which shall be creosote or heavy oil of coal tar, conforming to the specifications hereinafter set forth; and 25% shall be resin, conforming to the said specifications; and not less than 26 lbs. of the mixture shall be injected in all blocks, except those made from longleaf yellow pine, which shall contain not less than 20 lbs. per cubic foot.

METHOD OF TREATMENT. Blocks cut from the several classes of timber allowed under these specifications will require different manipulation and treatment, and for this reason the exact methods of applying the mixture to the several timbers named will not be specified, it being understood that whatever method is used the process

No 4.—Oakmont, Pa., Bridge Floor.
(Laid in 1909. Photographed Nov., 1916.)

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No. 5.—Washington St., Williams to Dudley St., Boston, Mass.
(Laid in 1911. Photographed Sept., 1916.)

must conform in every respect to the best and most advanced knowledge of the art, the purpose of the city being to allow the contractors to manufacture specification blocks by following any preferred detail, and by the use of any particular plan or machinery which may be properly adapted to secure the required results.

CREOSOTE. The creosote shall conform to the following specification when tested:

The specific gravity at 68° F. shall be not less than 1.12. When distilled in a retort with the thermometer suspended not less than 1 in. above the oil, it shall lose not more than 35% up to 565° F., and not more than 50% up to 665° F.

RESIN. The resin shall be solid, obtained from pine, and shall be incorporated with the creosote, heated sufficiently to melt the resin, in a suitable mixing tank until the proper mixture is secured.

## Exhibit "I."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 48° F. When distilled in a retort, with the thermometer suspended not less than 1 in. above the oil, it is to lose not more than 35% up to 315° C., and not more than 50% up to 370° C. The oil is to be free from adulteration; it is not to be mixed with or contain any foreign material.

## Exhibit "J."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 38° C. The oil is to contain not more than 5% of matter insoluble by continuous hot extraction with benzol and chloroform. The oil is to yield not more than 1% of distillate below 150° C., or more than 25% below 315° C., when distilled in accordance with the method described in Bulletin No. 65 of the American Railway Engineering Association. The oil is to be free from petroleum or asphaltic residue.

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## Exhibit "K."

PRESERVATIVE. The preservative shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

The specific gravity shall be not less than 1.10 nor more than 1.14 at a temperature of 38° C.

Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillate, based on water-free oil, shall not exceed ½% at 150° C., and shall be not less than 20% nor more than 40% at 315° C.

The oil shall contain not more than 3% of water.

The manufacturer of the blocks shall permit full and complete sampling at all times and places, and shall, if required, furnish satisfactory proof of the origin of the preservative.

Samples of the preservative, taken from the treating tank during treatment, shall at no time show an accumulation of more than 2% of sawdust, dirt or other foreign matter. Due allowance shall be made for such accumulation of foreign matter by injecting an additional quantity of oil into the blocks.

## Exhibit "L."

### WOOD BLOCK SPECIFICATIONS, CITY OF BRIDGEPORT, CONN.

The blocks shall be made from Southern yellow pine, and shall be free from unsoundness, shakes, or cracks or other defects which might impair the durability of the pavement. The annual rings shall average eight to the inch, but in no case shall be less than four to the inch measured radially.

No. 6.—East Cambridge, Mass., Howard Bridge.
(Laid in 1912. Photographed Sept., 1916.)

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The blocks shall be carefully sawed from 5 to 8 ins. long, 3½ ins. in depth, and 3 ins. in width. All blocks in one street shall be of uniform width.

The variation of 1/16 in. in depth and ⅛ in. in width of the blocks will be allowed.

The blocks shall be thoroughly seasoned by natural or artificial means, or methods which will insure the removal of all moisture, obviate checking and cracking, and shall be thoroughly impregnated with an antiseptic or preservative and water-proofing substance. Whatever process of seasoning be utilized, the blocks shall be completely deprived of all moisture as an absolute essential before final preservative and water-proofing treatment. No method will be allowed by which the checking of the blocks may not be entirely avoided. No particular method or treatment is required, it being understood that any method may be employed which may be adapted to the facilities and appliances of any properly equipped creosoting works, and which will insure the results required by these specifications.

The paving blocks when impregnated with the preservative shall contain at least 16 lbs. of preservative per cubic foot of wood.

The result required is a block whose pores are entirely free from moisture and thoroughly permeated by an antiseptic fluid, and rendered water-proof.

Sawdust from the treated blocks shall be extracted with benzol, and the extract distilled and tested.

Sample blocks taken at random when sawed or split through the middle shall show the treatment throughout, proper allowance being made for the impermeability of sound knots.

Treated blocks dried in an oven for 24 hours, or until they cease to lose weight, at a temperature of 120° F.; weighed in air and immersed in water for 24 hours, and again weighed, shall not show a gain in weight of more than 4½%.

The bidders will state the method of treatment and furnish to the Commission samples of the preservative used in treatment.

The material to be used as well as the finished treated blocks, will be subject to inspection at the plant as well as at the site of the work by the Engineer, or a representative of the Commission. The plant shall be provided with proper means of obtaining absolute measurement of amount of preservative per cubic foot of lumber. It shall have all necessary appliances to facilitate said work.

## Conclusions.

The Committee recommends for insertion in the MANUAL, the following:

1. *Definition of Tar,* as presented by Sub-Committee A, on page 280.

2. *Definition of Creosote,* as presented by Sub-Committee A, on page 280.

3. *Method of Analysis for Zinc Chloride,* as presented by Sub-Committee A, page 280.

The Committee recommends the repeal of the previously adopted Specification for Standard Thermometer, as presented by Sub-Committee A, on page 282.

The Committee recommends for adoption as standards and for insertion in the MANUAL the following specifications:

1. *Zinc Chloride* as proposed by Sub-Committee C, on page 326.

2. *Creosote for Ties and Structural Timber,* as proposed by Sub-Committee B, on page 307.

3. ~~*Creosote-Coal Tar Solution for Ties and Structural Timber,*~~ as proposed by Sub-Committee B, on page 307.

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4. *Coal-Tar Oil for Paving Blocks,* as proposed by Sub-Committee B, on page 308.

5. *Distillate Oil for Paving Blocks,* as proposed by Sub-Committee B, on page 308.

The Committee recommends for adoption as standard and for insertion in the MANUAL the following methods of analysis:

1. *Determination of Amount of Water,* as proposed by Sub-Committee B, on page 309.

2. *Determination of Amount Insoluble in Benzol,* as proposed by Sub-Committee B, on page 310.

3. *Determination of Specific Gravity,* as proposed by Sub-Committee B, on page 312.

4. *Distillation Test,* as proposed by Sub-Committee B, on page 313. (This includes a new specification for a thermometer).

5. *Determination of the Specific Gravity of Fractions,* as proposed by Sub-Committee B, on page 316.

6. *Float-Test,* as proposed by Sub-Committee B, on page 319.

7. *Determination of the Coke Residue,* as proposed by Sub-Committee B, on page 320.

The Committee presents as information a number of specifications for and methods of analysis of preservatives adopted by other associations, and data concerning the use of water-gas tar for treating paving blocks, together with a tentative specification for this material. This information is contained in the report of Sub-Committee A, on pages 283 to 306 and in the report of Sub-Committee D, on pages 48 to 55.

**Recommendations for Future Work.**

The Committee suggests for future work:

1. Continue the study of methods of sampling zinc chloride and creosote.

2. Continue the study of some of the tests for creosote, particularly the float-test, and the coke-test.

3. Report for information more detailed tests for differentiating between coal-tar oils, and water-gas-tar oils.

4. Continue the investigation of the use of water-gas tar products as wood-preservatives.

5. Begin a study of wood-preservatives other than zinc chloride and creosote.

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6. Investigate methods for determining the quantity and quality of preservative in treated timber.

E. B. FULKS, *Chairman*
S. F. ACREE
S. R. CHURCH
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## APPENDIX TO REPORT OF SUB-COMMITTEE B OF COMMITTEE ON PRESERVATIVES.

In this appendix data are submitted, showing:

(1). Tests of oils with particular reference to the use of the float test and the coke test; and

(2.) Tests of oils with particular reference to the value of the determination of specific gravity of fractions.

**1.—Float Test and Coke Test.**

Table 1 gives comparative tests made in the laboratories of several members of the Committee, on samples of oils prepared in one laboratory and sent to the other laboratories.

Table 2 consists of tests made in the laboratory of one member of the Committee on a rather comprehensive range of distillate oils and creosote-coal tar solutions received in the regular course of inspection of oils.

Table 3 gives tests made in the laboratory of a member of the Committee, illustrating the value of the float test on a creosote-coal tar solution and a coal-tar paving oil.

**2.—Specific Gravity.**

Table 4 gives tests made in the laboratory of one member of the Committee, showing the effect on the specific gravity of fractions when different percentages of water-gas tar are added to coal-tar paving oil.

Table 5 gives tests made in the laboratory of another member, showing the effect on specific gravity of fractions when different percentages of water-gas tar are added to creosote oil.

Tables 6 and 7 give tests made in the laboratory of a third member of the Committee, showing the effect of adding different percentages of water-gas tar from several sources to coal-tar paving oils.

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TABLE 1.—COMPARATIVE TEST MADE IN LABORATORIES OF SEVERAL MEMBERS OF COMMITTEE ON SAMPLES OF OILS PREPARED IN LABORATORY "C" AND SENT TO OTHER LABORATORIES.

| Test | Laboratory | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CREOSOTE-COAL TAR SOLUTIONS. | | | | COAL-TAR PAVING OILS. | | | | | |
| | | Contains 20% Filtered Coal Tar | 30% Filtered Coal Tar for Comparison with No. 1 | 20% Filtered Coal Tar | 30% Filtered Coal Tar for Comparison with No. 3 | 35% Filtered Coal Tar | 45% Filtered Coal Tar for Comparison with No. 5 | 35% Filtered Coal Tar | 45% Filtered Coal Tar for Comparison with No. 7 | Distillate Oil for Paving Blocks | Creosote Oil for Ties |
| Sp. Gr. at 38° C. | A | 1.098 | 1.104* | 1.074 | 1.088 | 1.107 | 1.112 | 1.088 | 1.088 | 1.088 | 1.072 |
| | B | 1.097 | 1.101* | 1.073 | 1.086 | 1.105 | 1.109 | 1.089 | 1.104 | 1.087 | 1.070 |
| | C | 1.098 | 1.104* | 1.073 | 1.088 | 1.105 | 1.110 | 1.088 | 1.106 | 1.088 | 1.070 |
| | D | 1.097 | 1.101* | 1.074 | 1.087 | 1.105 | 1.111 | 1.088 | 1.106 | 1.086 | 1.070 |
| Per Cent. Distilling Below 235° C. | A | 10.4 | 10.0 | 20.4 | 17.6 | 9.9 | 9.1 | 16.8 | 10.9 | 12.7 | 24.3 |
| | B | 9.5 | 8.3 | 16.7 | 12.8 | 6.4 | 6.1 | 13.2 | 9.1 | 10.2 | 22.4 |
| | C | 9.0 | 8.1 | 20.1 | 15.5 | 7.8 | 6.8 | 14.8 | 8.8 | 10.8 | 22.1 |
| | D | 9.0 | 8.4 | 17.9 | 14.6 | 11.6 | 11.0 | 12.6 | 10.3 | 13.4 | 21.7 |
| Sp. Gr. of Fraction 235-315° C. | A | 1.037 | 1.037 | 1.030 | 1.030 | 1.030 | 1.037 | 1.036 | 1.035 | 1.043 | 1.042 |
| | B | 1.032 | 1.032 | 1.031 | 1.031 | 1.032 | 1.033 | 1.028* | 1.033 | 1.030 | 1.034 |
| | C | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| | D | 1.033 | 1.038 | 1.029 | 1.033 | 1.038 | 1.040 | 1.029 | 1.036 | 1.038 | 1.038 |
| Sp. Gr. of Fraction 315-355° C. | A | 1.112 | 1.109 | 1.100 | 1.109 | 1.114 | 1.113 | 1.108 | 1.101 | 1.118 | 1.121 |
| | B | 1.100 | 1.110 | 1.103 | 1.103 | 1.102 | 1.096* | 1.087* | 1.096* | 1.102 | 1.115 |
| | C | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| | D | 1.100 | 1.102 | 1.102 | 1.108 | 1.105 | 1.102 | 1.098 | 1.104 | 1.109 | 1.102 |
| Per Cent. Residue at 355° C. | A | 37.3 | 38.1 | 25.5 | 30.5 | 37.0 | 39.0 | 30.7 | 38.0 | 34.0 | 22.0 |
| | B | 41.0 | 42.0 | 31.0 | 34.5 | 42.5 | 46.0 | 34.5 | 41.0 | 39.0 | 27.5 |
| | C | 39.0 | 38.4 | 26.8 | 30.9 | 39.8 | 40.0 | 32.1 | 38.3 | 37.3 | 26.0 |
| | D | 39.6 | 40.5 | 26.8 | 31.2 | 40.0 | 40.8 | 32.0 | 38.5 | 37.0 | 26.2 |
| | E | 35.7 | 37.0 | 24.6 | 29.8 | 37.4 | 30.3 | 31.3 | 37.8 | 32.7 | 33.4 |
| Float Test at 70° C (Seconds) | A | 28 | 40 | 44 | 64* | 60 | 92* | 125 | 129* | 40 | 40 |
| | B | 24 | 30 | 48 | 30(?) | 44 | 48 | 92 | 85* | 20 | 27 |
| | C | 38 | 47 | 44 | 69* | 64 | 109* | 97 | 117* | ..... | ..... |
| | D | 34 | 40 | 43 | 55* | 50 | 72 | 92 | 101* | 22 | 24 |
| | E | 42 | 56 | 52 | 78* | 65 | 110* | 108 | 137* | 35 | 37 |
| Per Cent. Coke Residue | A | 5.4 | 6.4* | 3.9 | 4.1 | 6.8 | 9.0 | 7.6 | 8.6 | 1.3 | 0.8 |
| | B | 5.0 | 7.3* | 5.0 | 6.2 | 7.7 | 11.3* | 9.2 | 10.1 | 1.1 | 1.0 |
| | C | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| | D | ..... | 5.1 | 5.1 | 5.4 | 8.8 | 9.9 | 8.9 | 8.1 | 1.8 | 1.3 |
| | E | 4.2 | 5.7 | 3.8 | 5.4 | 5.2 | 8.5 | 6.5 | 8.9 | 1.0 | 0.9 |

*Indicates failure to meet requirement of specification.

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TABLE NO. 2.—TESTS OF VARIOUS OILS MADE IN LABORATORY "B."

| Kind of Oil | Sp. Gr. at 38° C. | DISTILLATION Distillate Below 235° C. | DISTILLATION Residue Above 355° C | Sp. Gr. Fractions at 38/15.5° C. 235-315 | Sp. Gr. Fractions at 38/15.5° C. 315-355 | Float Test Sec. at 70° C. | Coke Residue |
|---|---|---|---|---|---|---|---|
| | | Per Cent. | Per Cent. | | | | |
| Distillate Creosote Oil (American).. | 1.105 | 0.7 | 51.7 | 1.039 | 1.096 | 32.0 | 0.4 |
| " " " (English)... | 1.041 | 24.1 | 13.8 | 1.027* | 1.087* | 35.0 | 1.8 |
| " " " " ..... | 1.050 | 11.1 | 14.5 | 1.016* | 1.079* | .... | .. |
| " " " (American).. | 1.079 | 15.8 | 18.5 | 1.045 | 1.117 | 46.5 | 1.4 |
| " " " " ..... | 1.090 | 1.2 | 23.5 | 1.040 | 1.108 | 36.5 | (?)3.5* |
| " " " " ..... | 1.086 | 9.7 | 22.0 | 1.042 | 1.106 | 32.0 | 0.8 |
| " " " " ..... | 1.070 | 22.4 | 27.5 | 1.034 | 1.115 | 27.0 | 1.0 |
| " " " " ..... | 1.087 | 10.2 | 39.0 | 1.030 | 1.102 | 20.0 | 1.1 |
| 80-20 Creosote-Coal Tar Solution... | 1.069 | 13.5 | 21.0 | 1.031 | 1.094 | 11.5 | 6.2 |
| " " " " " ... | 1.100 | .... | 31.0 | 1.041 | 1.110 | 21.0 | 5.1 |
| " " " " " ... | 1.095 | 14.0 | 29.0 | 1.042 | 1.104 | 25.0 | 4.5 |
| " " " " " ... | 1.100 | 7.7 | 33.0 | 1.042 | 1.120 | 28.0 | 4.6 |
| " " " " " ... | 1.097 | 9.5 | 41.0 | 1.032 | 1.100 | 25.0 | 5.0 |
| " " " " " ... | 1.073 | 16.7 | 31.0 | 1.031 | 1.103 | 48.0 | 5.0 |
| 65-35 Paving Oil..... | 1.111 | .... | 38.0 | 1.040 | 1.106 | 34.0 | 10.4 |
| " " " ..... | 1.105 | 6.4 | 42.5 | 1.032 | 1.102 | 44.5 | 7.7 |
| " " " ..... | 1.089 | 13.2 | 34.5 | 1.028 | 1.087 | 92.5 | 9.2 |

*Indicates failure to meet requirement of specification.

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TABLE 3.—TESTS ILLUSTRATING THE VALUE OF THE FLOAT TEST.
(Made in Laboratory "D").

| TEST | CREOSOTE-COAL TAR SOLUTION | | COAL-TAR PAVING OIL | |
|---|---|---|---|---|
| | Contains 20% Filtered Coal Tar | Contains 23% Filtered Coal Ttar | Contains 35% Filtered Coal tar | Contains 40% Filtered Coal Tar |
| Water, Per Cent | 0.3 | 0.4 | trace | trace |
| Insoluble in Benzol, Per Cent | 0.7 | 0.6 | 1.4 | 1.5 |
| Specific Gravity at 38° C. | 1.098 | 1.100 | 1.106 | 1.111 |
| Retort Distillation: 170° C. | 0.3 | 0.5 | ..... | ..... |
| 200° C. | 0.5 | 0.7 | 0.4 | ..... |
| 210° C. | 1.4 | 1.5 | 0.9 | 0.6 |
| 235° C. | 17.9 | 15.0 | 8.0 | 9.7 |
| 270° C. | 36.3 | 35.5 | 25.0 | 25.2 |
| 315° C. | 48.3 | 48.3 | 41.4 | 40.0 |
| 355° C. | 63.4 | 64.7(?) | 62.6 | 61.4 |
| Specific Gravity of Fraction 235-315° C. at 38/15.5° C. | 1.038 | 1.034 | 1.038 | 1.042 |
| Specific Gravity of Fraction 315-355° C. at 38/15.5° C. | 1.101 | 1.105 | 1.104 | 1.098 |
| Residue Above 355° C., Per Cent | 36.2 | 34.8(?) | 37.0 | 37.4 |
| Residue Above Float at 70° C., Sec. | 44.4-46.8 | 64.8-66* | 64.8-67.8 | 85.2-85.8* |
| Coke Residue, Per Cent | 5.2 | 5.5 | 6.7 | 7.8 |

*Indicates failure to meet requirement of specification.

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TABLE 4.—TEST SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR PAVING OIL.

(Made in Laboratory "C").

| TEST | 65% Distillate Oil 30% Water-Gas Tar 5% Coal Tar | 65% Distillate Oil 20% Water-Gas Tar 15% Coal Tar | 65% Distillate Oil 10% Water-Gas Tar 25% Coal Tar | 50% Distillate Oil 50% Water-Gas Tar |
|---|---|---|---|---|
| Water, Per Cent..... | 0.1 | 0.1 | 0.1 | 0.1 |
| Insoluble in Benzol, Per Cent..... | 0.7 | 1.3 | 1.9 | ..... |
| Specific Gravity at 38° C..... | 1.080 | 1.087 | 1.095 | 1.077 |
| Retort Distillation: 200° C..... | 0.4 | 0.3 | 0.2 | 0.6 |
| 210° C..... | 2.3 | 1.9 | 2.0 | 2.4 |
| 235° C..... | 17.8 | 17.6 | 16.9 | 16.6 |
| 315° C..... | 51.4 | 49.3 | 47.1 | 47.8 |
| 355° C..... | 65.1 | 63.7 | 61.0 | 62.9 |
| Specific Gravity of Fraction 235-315° C. at 38/15.5°C..... | 1.027* | 1.028* | 1.028* | 1.019* |
| Specific Gravity of Fraction 315-355° C. at 38/15.5°C..... | 1.093* | 1.099* | 1.102 | 1.083* |
| Residue Above 355° C., Per Cent..... | 34.2 | 35.6 | 38.2 | 36.4 |
| Residue Above Float at 70° C., Sec... | 58 | 60 | 65 | ..... |

*Indicates failure to meet requirement of specification.

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TABLE NO. 5.—TESTS SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR CREOSOTE OIL.

(Made in Laboratory "A").

| TEST | Creosote Oil | Creosote Oil Plus 10% Water-Gas Tar | Creosote Oil Plus 25% Water-Gas Tar |
|---|---|---|---|
| Specific Gravity at 38° C..... | 1.045 | 1.048 | 1.052 |
| Distillation to 235° C..... | 28.4 | 27.6 | 26.6 |
| Distillation to 315° C..... | 73.2 | 71.4 | 68.6 |
| Residue at 355 °C..... | 13.3 | 12.5 | 16.0 |
| Specific Gravity of Fraction 235/315° C..... | 1.034 | 1.033 | 1.024* |
| Specific Gravity of Fraction 315/355° C..... | 1.106 | 1.088* | 1.082* |
| Coke Residue, Per Cent..... | 0.9 | 3.43 | 4.46 |
| Float Test on Residue at 355° C., at 70° C., Sec..... | 24-25-26 | 64-62-66 | 147-137 |

*Indicates failure to meet requirement of specification.

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TABLE 6.—TESTS SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR PAVING OIL.

(Made in Laboratory "D").

(Three Grades of Water-Gas-Tar Used).

| Mixture | | Specific Gravity of Fraction | |
|---|---|---|---|
| | | 235-315° C. | 315-355° C. |
| Water-Gas Tar.....X<br>Creosote Oil.....<br>Coal Tar..... | 15%<br>65%<br>20% | 1.031 | 1.094* |
| Water-Gas Tar.....X<br>Creosote Oil.....<br>Coal Tar..... | 25%<br>65%<br>10% | 1.029* | 1.088* |
| Water-Gas Tar.....X<br>Creosote Oil..... | 40%<br>60% | 1.027* | 1.081* |
| Water-Gas Tar.....Y<br>Creosote Oil.....<br>Coal Tar..... | 15%<br>65%<br>20% | 1.033 | 1.085* |
| Water-Gas Tar.....Y<br>Creosote Oil..... | 35%<br>65% | 1.029* | 1.080* |
| Water-Gas Tar.....Z<br>Creosote Oil..... | 35%<br>65% | 1.033* | 1.081* |

*Indicates failure to meet requirement of specification.

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TABLE 7.—TESTS SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR PAVING OIL.

(Made in Laboratory "D").

(Two Grades of Creosote Oil Used).

| TEST | 65% Creo. A 20% Coal Tar 15% W.-G. Tar | 65% Creo. A 10% Coal Tar 25% W.-G. Tar | 65% Creo. A 35% W.-G. Tar | 65% Creo. B 20% Coal Tar 15% W.-G. Tar | 65% Creo. B 10% Coal Tar 25% W.-G. Tar | 65% Creo. B 35% W.-G. Tar |
|---|---|---|---|---|---|---|
| Water, Per Cent | 0 | 0 | 0 | 0 | 0 | 0 |
| Insoluble in Benzol, Per Cent | 2.8 | 2.6 | 1.9 | 2.5 | 2.3 | 2.0 |
| Specific Gravity at 38° C. | 1.087 | 1.083 | 1.087 | 1.122 | 1.127 | 1.129 |
| Retort Distillation: 170° C. | 0 | 0.2 | 0 | 0 | 0 | 0 |
| 200° C. | 0.1 | 0.8 | 0.1 | 0.3 | 0.4 | 0.2 |
| 210° C. | 1.2 | 1.6 | 0.9 | 0.6 | 0.6 | 0.4 |
| 235° C. | 18.5 | 19.4 | 16.4 | 4.0 | 3.5 | 2.7 |
| 315° C. | 55.2 | 54.9 | 53.3 | 33.3 | 32.5 | 30.9 |
| 355° C. | 67.8 | 68.5 | 66.8 | 54.8 | 54.2 | 53.0 |
| Specific Gravity of Fraction 235-315° C. at 38/15.5° C. | 1.020* | 1.024* | 1.026* | 1.041 | 1.038 | 1.039 |
| Specific Gravity of Fraction 315-355° C. at 38/15.5° C. | 1.096* | 1.097* | 1.087* | 1.111 | 1.106 | 1.104 |
| Residue Above 355° C., Per Cent | 31.9 | 30.8 | 32.5 | 44.5 | 45.3 | 46.3 |
| Residue Above Float at 70° C., Sec. | 132* | 375* | 477* | 54.6 | 65 | 81* |
| Coke Residue, Per Cent | 9.4 | 10.3* | 12.2* | 9.3 | 10.4* | 10.7* |

*Indicates failure to meet requirement of specification.

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## DISCUSSION OF REPORT OF SUB-COMMITTEE B OF COMMITTEE ON PRESERVATIVES.

**By Ellis R. Dutton.**

In the report of Sub-Committee B on page 307 of Committee on Preservatives, I notice that the specific gravity of the fraction 235° to 315° is raised to 1.03; and of fraction 315° to 355° to 1.10. The original specification was 1.02 and 1.09, respectively. Also on page 309, under "Distillate Oil," section 5, the same raise has been made. I do not see any necessity for this change in gravity, and surely, if the report of the Committee is to be taken as a whole, there is no necessity for this change, as from the reading of the report the water-gas-tar oil has given nearly as good results as the coal-tar oil, and the only reason for these changes in gravity, or for this section at all, is to prevent the use of a considerable quantity of water-gas tar.

The report of the Committee on Preservatives is very full and complete, and it is the best report I have seen along these lines, and especially it is very pertinent at this time to have a report on the use of water-gas tar, as the claims have been made by the producers of water-gas tar that it was almost as good, if not as good, a preservative as the coal-tar products.

From the investigation of this Committee it would appear that water-gas tar has given excellent results as a preservative in creosoted wood block work.

I am glad, indeed, that the various Committees of these societies are getting together on a standard specification for creosoted wood-block paving, one upon which the various manufacturers can agree, and which should be satisfactory to the purchasers.

I wish to thank the Committee for these excellent reports.

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## DISCUSSION OF REPORT OF COMMITTEE ON PRESERVATIVES.

**By Wm. A. Fisher.**

We have examined the report of the Committee on Preservatives with much interest and appreciation of the large amount of work accomplished and the excellent manner in which it is presented.

We are glad to note that for straight distillate oils there has been no let-down in the proposed specifications, which are in some respects even more stringent than those of the American Railway Engineering Association for Grade 1 oil, now generally considered as standard.

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In our dealings with the English distillers we have constantly endeavored to raise the grade of their product, and we are convinced that any retrogression whatever in the standards on this side would result in the loss of such success as we may have had in improving the quality of the English imports. The adoption of the American Railway Engineering Association standard some years ago did much to convince the English tar distillers that the American market demanded the highest grade of creosote, and if for no other reason therefore, we should be glad to see the present standards maintained.

In considering the question of specifications broadly, however, the commercial situation cannot be ignored. No matter how high may be our ideals in the matter of specifications and preservatives, we cannot lose sight of the fact that the war and the conditions resulting from it have cut off the important German oils from our market, and that while fortunately the English supplies have continued to come over with fair regularity, there is by no means any definite assurance that the latter also may not be cut off, and the industry left entirely dependent on the domestic production until hostilities cease.

In fact, our latest advices from the other side bring the disagreeable news that the British Government has given notice of its intention to commandeer for fuel purposes, presumably for the term of the war, quantities of English oil in amounts not yet announced, but said to be from 70,000 tons upwards. We are still hoping that a certain proportion of it may continue available for the American market. Should imports from this source continue undisturbed, however, there still remains the fact that some of the English oil does not fully meet all the requirements of the specifications proposed, particularly Clause 4, defining the limits which may distill off up to 235° C.

Now, 35 to 40% of last year's supply in this country came from England, and we believe that all grades of this oil will continue in demand as heretofore, for there is certainly not enough Grade 1 oil available to satisfy all consumers. If this is so, and we doubt that the statement can be seriously questioned, why not meet the situation squarely and adopt an additional specification similar to the Grade 2 A. R. E. A. specification?

The committee has touched on this point in the footnote on page 42. We should like to see it go further and present an additional specification so that uniformity and definiteness will be assured for the consumers who might buy these oils from choice or necessity, and we cannot see that such action would impair the effectiveness of the standard specification.

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## DISCUSSION OF THE PAVING-OIL SPECIFICATION PROPOSED BY THE JOINT COMMITTEES OF THE AMERICAN SOCIETY FOR TESTING MATERIALS, AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, SOUTHERN PINE ASSOCIATION, AMERICAN SOCIETY OF CIVIL ENGINEERS, AND THE AMERICAN WOOD-PRESERVERS' ASSOCIATION.*

By E. Bateman,

*Chemist in Forest Products, Forest Service.*

The specification for paving-block oil proposed by the joint meeting at Brooklyn, N. Y., in September, 1916, of the committees on paving blocks for the American Society for Testing Materials, the American Society of Municipal Improvements, the Southern Pine Association, the American Society of Civil Engineers, and the American Wood-Preservers' Association attempts to limit the amount of tar in tar solutions by the use of the coke test and "float test" and to guarantee the purity of the distillable portion by limiting the specific gravity of the two highest fractions. The coke test and float test will, in all probability, limit the amount of tar in solutions just so long as only coal tar is used. If, however, water-gas tar is added in place of coal tar, amounts up to 50% can be used without exceeding the limit set for the coke test and float test and, in certain cases, without falling below the limits, 1.020 and 1.090, set for the specific gravity of the fractions, 235° to 315° and 315° to 355°, respectively.†

The United States produces between 50,000,000 and 60,000,000 gals. of water-gas tar per annum, about one-third of which (it is conservatively estimated) could be used in tar solutions in this manner. The wood-preserving industry used in 1914 approximately 9,500,000 gals., and in 1915 approximately 3,000,000 gals. of paving oil (Proceedings of American Wood-Preservers' Association, 1916). There is, therefore, considerably more water-gas tar available for use in coal tar solutions than the total amount of paving oil used in both years combined.

The following experimental work was undertaken with a view of determining just how much water-gas tar could be added to coal tar without exceeding the limits laid down by this specification.

### Coke Residue.

The coke residue on a number of tars was obtained in the following manner:

*Presented to the Committee on Preservatives, American Wood-Preservers' Association, at their meeting in Cleveland, Nov. 14, 1916.

†The Committee raised the specific gravity of the fraction 235° to 315° C. from 1.020 to 1.030 and the specific gravity of the fraction 315° to 355° from 1.09 to 1.10.

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Two-gram samples of tar were accurately weighed into 35 mm. porcelain crucibles, tall form, covered with a 37 mm. porcelain crucible, low form. The crucibles were then gently heated until all the volatile matter had been expelled and were then exposed to the full flame of a Bunsen burner until the outside had been thoroughly burned free from carbon. They were then cooled in a desiccator and weighed. Duplicate samples were run, a difference of 10% of the coke residue being considered a check result. The figures given in the following table are the average of two or more determinations. The free carbon or matter insoluble in benzol was determined by the method proposed by the American Society for Testing Materials, 1916.

(Owing to the viscosity and, in some cases, the high carbon content of the tars, the bulb used in the N. E. L. A. test could not be used. The results here recorded may differ somewhat from those which might have been obtained if the bulb could have been used. It is believed, however, that if anything the results may be slightly too high, but the error must be small since the author has been able to calculate with reasonable accuracy the coke residue of solutions, using these figures as a basis.)

TABLE 1.

| Kind of tar. | Tar no. | Free carbon content. | Coke residue. | Bituminous coke residue. |
|---|---|---|---|---|
| High or Medium Free Carbon. | 1 | 37.1 | 57.2 | 20.1 |
| | 2 | 18.6 | 43.5 | 24.9 |
| | 3 | 16.2 | 42.9 | 26.7 |
| | 4 | 15.4 | 34.4 | 19.0 |
| Low Carbon Coal. | 5 | 7.6 | 26.8 | 19.2 |
| | 6 | 6.7 | 27.0 | 20.3 |
| | 7 | 5.4 | 28.4 | 23.0 |
| | 8 | 5.2 | 30.6 | 25.4 |
| | 9 | 4.4 | 29.4 | 25.0 |
| Water-Gas. | 10 | 1.3 | 25.3 | 24.0 |
| | 11 | 1.1 | 28.1 | 27.0 |
| | 12 | .1 | 23.2 | 23.1 |
| | 13 | .. | 18.2 | 18.2 |

It is to be noted that there is a considerable variation in the coke residue being higher in those tars with a high carbon content and lower in water-gas tars. It is to be noted further that if the percentage of insoluble matter in benzol be subtracted from the percentage of coke residue a figure is obtained which, for want of a better term, we will call "bituminous coke residue." This bituminous coke residue is nearly constant for all three classes of tar shown in Table 1.

A coke residue of 10% will, according to the above figures, admit from 33 to 37% of low carbon tar, but may admit from 35 to 50% of water-gas tar. In other words, the coke residue as it stands at present gives an incentive for the substitution of water-gas tar for coal tar, since more of the former can be added and still fulfill the coke test. If, however, the wording of the specification be changed to read:

> "Material insoluble in benzol shall not exceed 3% and the bituminous coke residue (that is, the percentage of coke residue minus the percentage of matter insoluble in benzol) shall not exceed 7%,"

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then it will restrict the coal tar to about the same limits (28 to 37%) and the water-gas tar to from 26 to 39%, or, in other words, it will limit the two classes of tar to about the same amount instead of favoring water-gas tar.

**Specific Gravity of Fractions.**

The specific gravity of the fractions of creosote will, of course, vary to some extent with the percentage composition of the creosotes. They will also vary with the tars from which they were produced. In general, those tars which were formed at high temperatures, produce creosotes whose fractions have high specific gravities, and those tars produced at lower temperatures have somewhat lower gravities.

In some previous work on the properties of coal-tar creosotes and water-gas tar distillates, this Laboratory [Forest Products Laboratory] had occasion to collect approximately 50 tars from all sections of the country and from all types of retorts and coke ovens. From these tars three have been selected, from which creosotes have been produced in the Laboratory. One of these tars yields fractions whose specific gravity is the highest of the entire collection; another is about the average, while the third has a low specific gravity. The distillation of these oils and the specific gravity of their fractions are shown in Table 2.

TABLE 2.

| Mixture Contains. | Distillate Up to | | | | Sp. Gr.—38/15 | Sp. Gr.—38/15 |
|---|---|---|---|---|---|---|
| | 210° | 235° | 315° | 355° | 235° to 315° | 315° to 355° |
| Creosote No. 1 (High Gravity)..... | .. | 18.3 | 65.1 | 87.0 | 1.047 | 1.145 |
| Creosote No. 2 (Average Gravity).. | 1.6 | 21.6 | 73.7 | 91.9 | 1.036 | 1.112 |
| Creosote No. 3 (Low Gravity)..... | 1.9 | 18.3 | 70.1 | 88.9 | 1.025 | 1.108 |

It is interesting to note that all of the tar solutions except Nos. 1 and 4 passed all the specifications for the American Society for Municipal Improvements, except that they are not pure coal-tar products. They contain anywhere from 15 to 35% of water-gas tar, and from 35 to 50% of total tar.

Out of a total of five solutions containing 40, 45, 45, 50, and 50% of total tar, one containing 35% water-gas tar and 15% coal tar is eliminated by the coke test, and probably by the float test. One (containing 45% water-gas tar) passes the coke test, but is thrown out by the float test. In both these cases, if the creosote oil had been lower boiling, the float test would not have been applied since the residues on distillation up to 355° C. were 36.4 and 35.5%, respectively. The other three solutions, containing 40, 45 and 50% of total tar, respectively, are admitted since the residue on distillation up to 355° C. is less than 35% (viz., 21, 24, 31%, respectively).

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TABLE 3—ANALYSIS OF TAR SOLUTIONS.

| No. | Tar Solution. Composition of | Sp. Gr. | Carbon. Free | Residue. Coke | Residue Bit. Coke | 210° 235° 315° Distillates | | | Up to 355° | Residue. | Sp. Gr. 235-315° | Sp. Gr. 315-355° | Float Test. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Creosote No. 1..55%<br>Water-Gas Tar..45% | 1.095 | Trace | 10.0 | 10.0 | 1.6 | 12.3 | 46.2 | 63.5 | 36.4 | 1.038 | 1.112 | Over 160 Sec. |
| 2 | Creosote No. 1..65%<br>Water-Gas Tar..35% | 1.086 | Trace | 7.3 | 7.3 | 3.0 | 17.6 | 51.6 | 72.3 | 27.5 | 1.042 | 1.120 | Residue less than 35%. |
| 3 | Creosote No. 2..60%<br>Water-Gas Tar..15%<br>Coal Tar.....25% | 1.085 | 1.6 | 8.3 | 6.7 | 4.1 | 17.4 | 53.0 | 68.6 | 21.0 | 1.028 | 1.104 | Residue less than 35%. |
| 4 | Creosote No. 2..50%<br>Water-Gas Tar..35%<br>Coal Tar.....15% | 1.094 | 1.0 | 11.8 | 10.8 | 2.6 | 15.6 | 49.4 | 64.4 | 35.5 | 1.028 | 1.101 | Not taken—thrown out by coke residue. |
| 5 | Creosote No. 3..65%<br>Water-Gas Tar..35% | 1.072 | Trace | 7.1 | 7.1 | 1.6 | 14.9 | 53.8 | 71.7 | 27.9 | 1.024 | 1.094 | Not taken—residue less than 35%. |
| 6 | Creosote No. 3..55%<br>Water-Gas Tar.22.5%<br>Coal Tar.....22.5% | 1.075 | 1.7 | 9.7 | 8.0 | 4.8 | 13.4 | 49.1 | 75.4 | 24.3 | 1.025 | 1.100 | Not taken—residue less than 35%. |
| 7 | Com'l Creosote..65%<br>Water-Gas Tar..35% | 1.079 | Trace | 7.6 | 7.6 | .. | 14.0 | 64.6 | 78.1 | 21.8 | 1.020 | 1.090 | Not taken—residue less than 35%. |
| 8 | Com'l Creosote..65%<br>Water-Gas Tar..35% | 1.073 | Trace | 8.0 | 8.0 | .. | 10.7 | 54.6 | 72.8 | 27.0 | 1.023 | 1.091 | Not taken—residue less than 35%. |
| 9 | Com'l Creosote..50%<br>Water-Gas Tar..25%<br>Coal Tar.....25% | 1.092 | 1.9 | 10.0 | 8.1 | 2.1 | 13.3 | 55.8 | 69.1 | 30.5 | 1.026 | 1.091 | Not taken—residue less than 35%. |

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All of the solutions have fractions whose specific gravities are well within the limits set by the specification.

Only one of these nine solutions would pass the tests if the specific gravities of the fractions were raised from 1.020 and 1.090 to 1.035 and 1.105, respectively, and the other tests (coke test and float test) remain the same. And none of them would pass if the specific gravities of the fractions were raised as above and the coke test were changed to read:

> "The bituminous coke residue (viz., the per cent. coke residue minus the per cent. of free carbon) shall not exceed 7%."

It is evident from the above that the test as proposed by the Joint Committee does not insure the purchaser of the pure coal-tar product. Neither does it guarantee that not more than 35% of tar shall be added. It is the opinion of the author that at the present time there are no tests which will infallibly separate a pure coal-tar product from a mixture of certain water-gas tars and certain coal-tar products, but the percentage of water-gas tars available for such mixtures can be very materially reduced by more rigid limits.

There seems to be two courses available, either of which, or both, may be followed. These are:

First, we should change the specification to read,—

*a.* The specific gravity at 38° C., referred to water at 15.5, of the fraction boiling between 235° and 315° shall not be less than 1.035.

*b.* The specific gravity at 38° C., referred to water at 15.5, of the fraction 315° to 355° shall not be less than 1.105.

*c.* The bituminous coke residue, that is, the per cent. of coke residue, minus the per cent. insoluble in benzol shall not exceed 7%.

Such a specification will include practically all pure coal-tar products. It will not, however, exclude completely water-gas tar products. Selected water-gas tars mixed with selected coal tars may still be used to the extent of 35% of water-gas tar, but the amount of water-gas tar available for such a mixture is considerably lessened by the change in the specification.

The second course would be to change the wording of the specification to read: "The oil shall contain at least 65% coal-tar creosote. The remaining 35% may be refined or filtered, retort or coke-oven tar or water-gas tar and shall have the following properties:

*a.* The specific gravity at 38° C., referred to water at 15.5, of the fraction 235° to 315° shall not be less than 1.020.

*b.* The specific gravity of 38° C., referred to water at 15.5, of the fraction 315° to 355° shall not be less than 1.090.

*c.* The bituminous coke residue, that is, the per cent. of coke residue minus the per cent insoluble in benzol shall not exceed 7%.

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This specification is the same as the one proposed, except that it openly permits the use of water-gas tar and changes the coke residue to bituminous coke residue to provide a means for limiting the water-gas tar to 35%.

The specification for distillate oil should have the specific gravity of the fractions raised as in the case of the paving oil, if a pure coal-tar distillate is desired. It must be frankly confessed, however, that even under these raised gravities oil may contain a considerable portion of water-gas tar distillates, if the tars from which they are produced are selected especially for this purpose.

MR. E. B. FULKS: Mr. President, that concludes the report of the Committee, with the exception of some recommendations for future work and the presentation as information of a great deal of very valuable matter to which I referred before. I believe the Committee has nothing further to present as a Committee. The President tells me it is necessary to move the acceptance of the report. I move the acceptance of the report, and that this matter be submitted as information, this matter that is referred to here on these various pages.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: All those in favor of accepting the remainder of the Committee's report as information—are there any remarks? If not, all those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: That includes all the report of the Committee, and, Mr. President, Sub-Committee "D" has presented, as I said before, a great deal of valuable work about water-gas tar, and in connection with this Mr. Fulweiler desires to make some statement. In the meantime, will you excuse the Committee?

THE PRESIDENT: The Committee is excused.

DR. H. VON SCHRENK: Before the Committee is excused, I would like to make a motion. I remember last year during the meetings and during the winter the President tried to emphasize the desirability of engaging upon a policy of very constructive work. While this may be a little out of the ordinary, I believe that the work which this Committee has done deserves some special notice. It has done an amount of work I think most of us appreciate to a slight extent anyway, and before the Committee is excused I would like to move that a vote of appreciation and commendation be given on the part of the organization to the Committee for the work it has done.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: All those in favor of that motion will please stand. The motion is carried.

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MR. E. B. FULKS: Mr. President, the Committee feels highly gratified.

MR. A. E. LARKIN: Mr. President, before the Committee is excused, would it not be in order to at least mention the recommendation for future work. Mention of this has been made from the floor, and it is important that certain work along new lines be done by this Committee during the next year.

THE PRESIDENT: Mr. Larkin, I am going to give opportunity just after the Committee is dismissed for anything of that kind, but I think it is in perfect order to have those read if you care to read them, that is, the recommendations of this Committee for future work, if that is what you refer to?

MR. A. E. LARKIN: Yes.

THE PRESIDENT: I will ask the Chairman to read those.

MR. E. B. FULKS: Of course, the Committee did not necessarily mean that the future work should be confined to this. This is something that occurred to the Committee at the time, and any other instructions that the Association sees fit to give are perfectly proper, but the things that occurred to the Committee were the recommendations for future work given in the report.

MR. WM. A. FISHER: Will you entertain the motion that I previously made, at this time?

THE PRESIDENT: Yes.

MR. WM. A. FISHER: If so, I will present it.

THE PRESIDENT: All right.

MR. WM. A. FISHER: For reasons which I gave previously, I move the Committee be instructed to present next year additional distillate oil specifications similar to those of the American Railway Engineering Association, known as Grades 2 and 3 Specifications.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried. The Committee is excused.

Now, gentlemen, I am holding you over the lunch hour a little bit, but I feel this is very important, and we have a pretty good audience. I would like to get through with the rest of this work before we dismiss. There are now one or two points with reference to oil that I am going to give the members an opportunity to present, and would like to have you act on them if you care to take any such action. However, I will ask these gentlemen to be as brief as possible, in view of the

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fact that the lunch time has arrived, and we have several matters yet to act upon before we will be able to adjourn.

MR. W. H. FULWEILER: Mr. Chairman and Gentlemen, according to the instructions of the Executive Committee, the Committee on Preservatives this year was unable to consider or present for adoption a specification on water-gas tar oil for paving blocks. Sub-Committee "D" has done a great deal of work on this subject and suggested a specification for water-gas-tar paving oil which was presented as information in the Committee's report.

We feel that this specification is worthy of further consideration, inasmuch as this year a general effort is being made to standardize certain specifications for preserving oils for wood-block paving among the various societies working to that end. This specification, with the specification for coal-tar oils presented by the Committee, have already been presented to the Society of Municipal Improvements and also to the American Society of Civil Engineers, and will probably be presented to other societies.

I therefore ask your consideration as to whether this would not be a very advisable time to have it adopted as a standard and included in the MANUAL, along with the other specifications, probably with the insertion of a paragraph, as is the practice, I believe, in the A. R. E. A. Manual, saying that water-gas-tar has been used for a number of years in treating wood blocks, and has apparently given excellent satisfaction. Therefore the Association would simply say that for people desiring to use this class of material we submit the specification for their guidance. I think such a paragraph should properly go in. The specification presented in the report of the Sub-Committee is a specification that has been in practical use for about eight years and covers a good many thousand square yards of wood-block paving. It has already been presented to several other societies, and is a specification that, in actual point of age and period of service, is probably older than the specifications presented here today. As I am not a Corporate member, I am going to ask Mr. Williams, who is, to make a motion concerning this proposition.

MR. J. C. WILLIAMS: Mr. President, along the lines of Mr. Fulweiler's remarks, I will simply say that in my own experience water-gas tar as a preservative for wood blocks answers all the requirements as given on page 2 of the report of the Committee on Specifications, for the Purchase and Preservation of Treatable Timber. I, therefore, have no hesitancy in offering this motion. I move that the specification for water-gas tar for paving blocks, as recommended by Sub-Committee "D," be adopted as a standard specification for water-gas tar and printed in the MANUAL for the guidance of those who desire to use this preservative.

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THE PRESIDENT: Is there a second to the motion?

MR. C. N. FORREST: I second the motion.

THE PRESIDENT: Any remarks?

MR. A. L. KUEHN: I think we have all observed how thoroughly the Committee has done its work, and as the Chairman explained, it has recommended all that it felt it was sure of. I think we should support the Committee in the recommendations as it made them.

DR. H. VON SCHRENK: I want to endorse that statement. In a progressive and successful organization of this sort success will come only when we depend upon those who have given most careful study and attention to the matter at hand, and follow it. Every technical organization in the country that has succeeded has done that. While the report of the Committee has given light and a new viewpoint, I certainly feel it is not the time to adopt that as standard until we have a great deal more and additional information, which the Committee assures us we will get next year. I believe that motion should not prevail.

THE PRESIDENT: Are you ready for the question?

MR. GEO. M. HUNT: I want to speak in favor of this motion. I think the time has come when this Association can go on record in favor of such a motion as Mr. Williams makes. We do not recommend the water-gas tar for any purpose at all. We simply say, if you want to use water-gas tar and want to know how to get a good water-gas tar, here is the way to do it. That is the same thing we did with the creosote-coal-tar solution. Why throw out water-gas tar and admit the solution? If we do one, we ought to do the other, in order to be fair to everyone concerned. I am very much in favor, therefore, of Mr. Williams' motion. It is absolutely fair to all in the wood-preserving industry and unfair to no one. It would be unfair to some people if the motion were killed.

THE PRESIDENT: Are you ready for the question?

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion will please signify it by saying "aye"; contrary, "no." I guess we will have to call for a rising vote. There was a good deal of noise and it was impossible to decide the vote. All those in favor of the motion will please stand up. All those opposed, will please stand.

SECRETARY ANGIER: The vote is 29 to 9.

THE PRESIDENT: The motion is carried.

I believe there is another matter to be presented at this time, and I will now ask Mr. Teesdale to present it.

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MR. C. H. TEESDALE: This paragraph is in the Manual of the American Railway Engineering Association and was voted upon at the time that the specification for the coal-tar solution was adopted. I feel very strongly that it should be included in our MANUAL, with reference to the coal-tar-creosote solution for ties. Mr. President, I would like to move the adoption of this paragraph and its insertion in the proper place in the MANUAL. I will read it again, if you wish.

THE PRESIDENT: If you will, please. I think it would be a good idea.

MR. C. H. TEESDALE:

> This specification is submitted for the guidance of those desiring to use the coal tar addition to creosote for ties only, which practice is firmly established and widely followed. The creosote-coal-tar solution is not recommended as equal to creosote in preservative quality, and should be used for ties only when the available supply of creosote is inadequate.

THE PRESIDENT: Is there a second to this motion?

MR. W. F. GOLTRA: I second the motion.

THE PRESIDENT: Are there any remarks?

MR. S. R. CHURCH: I would ask that the Association give this motion careful consideration before taking action. The last statement in the proposed paragraph is a pretty strong one, and it is perhaps only fair to say that it is not in accordance with the belief of a good many treating-plant operators. I do not know whether this Association should commit itself definitely to that statement or not, especially in view of the specifications that have just been adopted by the Committee. In other words, the Association has already taken such action as will tend to prevent any misunderstanding on this subject. We have protected the purchasers to that extent, and I merely ask for due consideration before committing ourselves to a definite statement that the "solution" should not be used except when the supply of distillate oil is inadequate.

MR. A. E. LARKIN: Mr. President, it is imperative that this Association should make certain recommendations with reference to the preservatives to be used, qualifying their use for certain kinds of work and giving certain information that is required by everyone interested.

MR. A. L. KUEHN: Mr. Chairman, I stated before that this Committee had done good work. We are also satisfied that this Committee has done very thorough work. It has made a statement, a few men have gotten up here and made some statements as to grading of these specifications. I think it is due the Association to have presented to it by its Committee, complete and thorough information on

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which it can intelligently base such decision. I would like to amend that motion that this matter be referred to the Committee for thorough investigation.

MR. WALTER BUEHLER: I second the amendment.

THE PRESIDENT: Are there any remarks on the amendment to the motion? Are you ready for the amendement? All those in favor of the amendment that this paragraph be referred to the Committee for its study and consideration will please signify by saying "aye"; all those opposed, "no." The amendment is lost.

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion that this paragraph precede the specification in this report, signify it by saying "aye"; all those opposed, "no." The motion is carried.

MR. A. E. LARKIN: Mr. President, I move that the Preservatives Committee be instructed to bring before us its recommendations setting forth the best oil in each class and specify them as No. 1 and No. 2, or "A" and "B," in order that the members of the Association can have some guidance in their work.

THE PRESIDENT: Is there a second to this motion? The motion is passed for want of a second. Are there any further matters?

MR. S. F. ACREE: Mr. Chairman, I would like to move an amendment to Section 5 on page 345, which reads:

> Begin a study of wood-preservatives other than zinc chloride and creosote,

and have added the words, "such as hardwood-tar creosote."

THE PRESIDENT: Mr. Acree, is that in any portion of the report that has already been passed upon?

MR. S. F. ACREE: Yes.

THE PRESIDENT: Well, I am afraid you are a little too late for that.

MR. S. F. ACREE: May I make this motion, that the Committee be instructed to begin next year a study of wood-preservatives other than zinc chloride and creosote, such as hardwood-tar creosote? I would like to have the motion put in that way. I would like to say briefly my reason for asking for the study of hardwood-tar creosote is the following: The Forest Products Laboratory has made a number of tests on the protection obtained from hardwood distillates, such as hardwood-tar creosote, and found it an excellent disinfectant, the high-boiling portions penetrating the wood nicely.

It is, furthermore, a fact that the hardwood distillation industry is thinking of going into the utilization of their tar, which at present,

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as you know, is practically a waste product, and to begin the distillation on a large scale, with the expectation of putting these materials before the public.

Since we have already had some study, and since a number of people are using creosote of this kind, and have informed me personally that they would be glad to try this material out thoroughly if given an opportunity, it seems that these materials are worthy of some consideration. Therefore, there ought to be some extensive study made of these oils, and I suggest this as one of the subjects, along with zinc chloride and creosote.

MR. W. F. GOLTRA: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. Are there any remarks? All those in favor of the motion say "aye"; contrary, "no." The motion is carried. Anything further?

MR. M. K. TRUMBULL: Place of next meeting.

THE PRESIDENT: I hope that this will only take a brief time. I regret very much that I felt it necessary to hold you over until this hour. I will now ask the Secretary to read communications with reference to a meeting place for 1918.

SECRETARY ANGIER: Just before I read these telegrams, it may interest you to know that our total registration up to this moment is 199; members 97 and guests 102. In addition to the invitations read yesterday, the following telegrams were received this morning: From the New Orleans Association of Commerce; the Mayor of New Orleans; from Mr. Manley, a member of this Association in New Orleans; and from the Chicago Association of Commerce (applause.) This is supplemented by a telegram from William Hale Thompson, Mayor of Chicago.

TELEGRAMS

FROM NEW ORLEANS ASSOCIATION OF COMMERCE
ERNEST LEE JAHNCKE, *President.*

We cordially invite the American Wood-Preservers' Association to hold its 1918 Convention in the city of New Orleans. Will do everything possible contribute to the success of convention if held here.

FROM MAYOR MARTIN BEHRMAN OF NEW ORLEANS

Speaking for myself personally and in my official capacity, I beg to extend a most cordial invitation to the American Wood-Preservers' Association to hold its next annual convention in this city. A cordial welcome awaits them, and all possible co-operation will be rendered in making a success of the meeting should it be held in New Orleans.

FROM MR. R. S. MANLEY, *Member of A. W.-P. A.*

Extend to the Association the combined invitation of the Creosoters in this vicinity. We promise blue skies, balmy days, mocking bird serenades, and a neat but not gaudy welcome to all.

FROM CHICAGO ASSOCIATION OF COMMERCE
GEORGE M. SPANGLER, JR., *Manager, Bureau of Conventions.*

Will you kindly present to the American Wood-Preservers' Association assembled in convention a cordial invitation on behalf of Chi-

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cago's commercial and civic interests to convene their 1918 meeting in Chicago? Every requirement for a successful convention is well met in Chicago, and we urge favorable consideration of Chicago's invitation.

FROM MAYOR WILLIAM HALE THOMPSON OF CHICAGO.

It will be a great pleasure for the city of Chicago to offer to the American Wood-Preservers' Association the hospitality of our city in 1918, and we urge your acceptance of Chicago's invitation.

THE PRESIDENT: Gentlemen, how shall we proceed to select this meeting place for next year? Bear in mind, of course, our lack of time.

MR. WALTER BUEHLER: Mr. President, it has been customary to have a written ballot, but due to the lack of time I suggest that we nominate certain cities and then take a standing vote by cities. I think this would hurry the matter.

THE PRESIDENT: Is there any objection to this plan that has been offered? If not, we will follow this plan. Nominations are now in order for the different cities.

MR. WALTER BUEHLER: I nominate Chicago as our next place of meeting.

MR. A. R. JOYCE: I second that.

MR. F. P. HAMILTON: Mr. President, I would like to nominate New Orleans.

THE PRESIDENT: Is there a second?

MR. C. H. TEESDALE: Mr. President, I move that the nominations be closed.

MR. A. R. JOYCE: I second the motion.

THE PRESIDENT: All those in favor of the motion that the nominations be closed will please signify it by saying "aye"; contrary, "no." The nominations are closed.

MR. J. H. WATERMAN: I move you we have a rising vote for Chicago (applause.)

THE PRESIDENT: I do not believe that is in order, because that has already been suggested, Mr. Waterman. All those that are in favor of Chicago will please rise to their feet.

MR. M. K. TRUMBULL: I think it ought to be clear as to whether corporate members only have a vote.

THE PRESIDENT: Gentlemen, our Constitution says that only corporate members are allowed to vote. Therefore the voting will be limited to corporate members only. All those in favor of Chicago will please stand up. (27 stood up.) All those in favor of New Or-

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leans will please stand up. (27 stood up.) The vote is a tie, gentlemen—27 to 27 (laughter.)

MR. J. H. WATERMAN: It is up to the President.

THE PRESIDENT: If it is left to me to decide I will have to vote in favor of Chicago (applause.)

MR. J. H. WATERMAN: It is all settled.

THE PRESIDENT: Gentlemen, if there are no announcements of any kind, we will now adjourn for lunch; but I would like to say that we have some very interesting papers to come before the convention, together with some Committee reports, this afternoon, and I will ask you to be back as nearly at 2 o'clock as it is possible for you to be. The convention is now adjourned.

An adjournment was then taken till 2 o'clock P. M.

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## WEDNESDAY AFTERNOON SESSION.

**January 24.**

The meeting was called to order at 2 o'clock P. M. by President Crawford.

THE PRESIDENT: Gentlemen, the first thing on the program this afternoon is, "The Bad and the Good in the Handling of Wood," by Mr. J. H. Waterman and Mr. George E. Rex. Mr. Waterman will say a few words just before the lights are turned out, and after he has made a few remarks he will begin with the pictures.

MR. J. H. WATERMAN: I want to say to you, gentlemen, first, that through the kindness of very many people I am able to give you the pictures which will be thrown on the screen this afternoon. I have one or two from Dr. von Schrenk and our good friend, Mr. Rex, has furnished some, and some from Mr. Angier, but there is nothing in any of the pictures that will give anybody away, especially those that are bad. None of you need be afraid—now just look at that proposition up there (referring to screen)! Is that not a rotten mess (laughter)? That belonged to John Brown. I am not going to do anything of the kind, and the only thing I am sorry for is that I did not get one or two pictures from our worthy President.

I passed Air Line Junction the other day, and I have a right to say this, Mr. President, if I want to. I saw the ties piled on that yard, and I wish we could throw them on the screen in a moving picture, and I think some of us would go home blushing. I am sure I would for one. Turn out the lights (laughter). Mr. President, you must not count this out of my time (laughter). I thought the Secretary had the pictures all ready to present.

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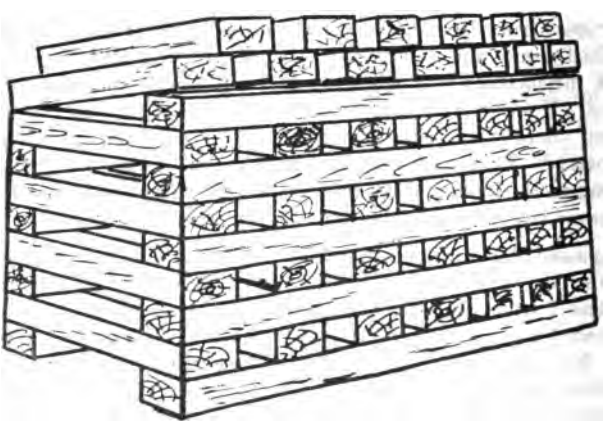
In order to treat ties you have to get them from some place, and here is a picture showing how they are piled on the right-of-way for inspection. Sometimes they lie around until they are all decayed or partially decayed before they are taken up.

Now, in some parts of this country they stand ties on end to receive them. There you see what happens if the ties stand around for

Ties Stood on End.

weeks or months, and the weather is wet and damp, and the ground is not favorable for piling ties for seasoning. I am told by men that went out to take those pictures that the ends next to the ground were in many cases decayed before they were taken up.



Method of Piling Ties.

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This picture is to show how ties ought to be piled on the right-of-way. They should be piled 7 and 2. Dr. von Schrenk is the man that gave that scheme to the Burlington Road.

Tie-Plant Yard.

Here is a view of a tie plant yard I am simply giving you this because there may be some men in the audience that have never seen a tie plant, and so you can get an idea how a plant looks. Then you will understand what we do.

Here is a picture of some cypress ties. Sometimes we talk about cypress being eternal wood, and that it does not need treating. However, you will notice that is sap cypress. I know a road in this country that gets the best kind of service out of cypress ties of this description, after treatment. You will notice everyone of them has practically the heart in them. Those that are familiar with wood know that they are cut from small timber.

Here is the front of a modern tie plant. You will note it is concrete. There are five retorts, apparently there, and room for another one. Here they are preparing to pull out a charge of ties from the retort.

Here is a loading platform. Most of you understand how ties are loaded at the platform, but I thought that I would give you these few pictures in order that those who were not familiar with tie plant operations might grasp the situation.

Here is an engine room. You will notice the recording gauges and all other gauges are all together and also the valves, so that the man does not necessarily have to run all around his retort, under them and over them, in order to open and close valves.

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Ties Badly Piled.

Here is a bad pile. You will notice these ties are piled solid. Now, men, how can you season ties piled like that? It is simply a physical impossibility. Those ties are lying there, and the longer they lie the poorer they will get, and by and by when you treat them they will all be blistered, and if the fungi have not started on them, if you will cut the ends open you will find that they are not worth treating.

Loading Ties on Trams for Treatment.

Here is a yard where you see that they are loading trams of ties, properly piled. Those ties are seasoned, thoroughly seasoned, if you leave them long enough, and a tie, I think, should be on hand at least a

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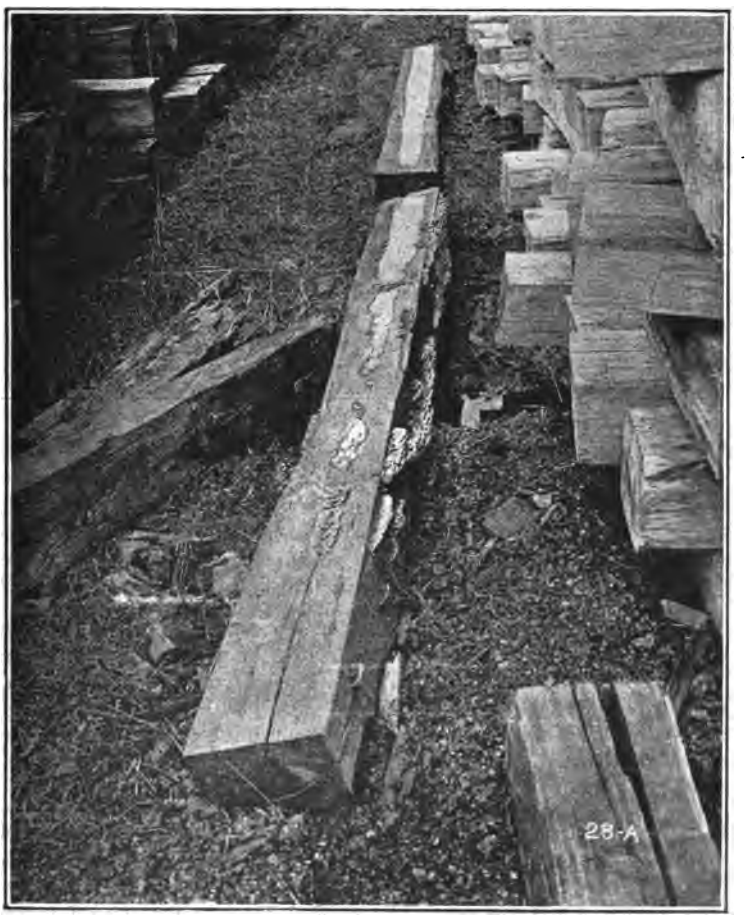
year before it is treated. Some people differ with me on that, but I would rather have it on hand a year than two months.

This is the way to pile piling to season. Piling piled up in that way and left there a year will treat fine. Those you will note are red-oak piling. You will see they are being handled by a locomotive crane. That is the only way and the proper way to handle piling.




Decaying Timber in a Badly Kept Yard.

Here is a picture. How does that look to you? Is not that fine? What would you think of a material yard or a tie plant yard like that? There is poison enough in one tie to poison a hundred thousand ties,

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if I am properly informed. Look at the grass and the weeds. You would think the insurance agents would get after them, if no one else did. Why, that would not make good firewood, let alone ties.

Decaying Untreated White Oak Ties.

There are some ties, gentlemen, white oak ties, after five years' service. Twenty-five per cent. of the ties in the mile of track where those were taken out were taken out after 5 years' service. I estimate that 25% will be taken out next year, that is 6 years; 25% at the end of 7 years, and 25% at the end of 8 years. Now, some of you mathematicians, tell us what the average life will be.

I say it is a crime to waste timber that way. What ought we to do? We ought to treat all our white oak the same as we do others (applause). It is fair and just for me to say to you that these ties came from south of the Ohio River—most of them, probably all of them—and the white oak in the South is not quite as firm as the white oak in the North.

What do you think of that, gentlemen? There is a fir tie that has literally been destroyed. I know all about it. That tie was in track 6 years. The track right along side of it, that was laid with treated fir ties, lasted 16 years. Why one 6 years and the other 16 years? This was light rail and no tie-plates. The track at the side of it was tie-plated and heavy rail. I want to show you two or three more pictures on that, and then I want to make some remarks. There are some more. Look at them—literally, mechanically worn out. Why? Simply because they were not mechanically protected. Here is another

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bunch, and I will say here without fear of contradiction that not a trunk line in these United States that runs heavy power but that I can go on its line and find in its side tracks thousands of ties destroyed like that. What does that mean? That means if the treating engineers of this country have reached the point where they can treat timber that will outlast the mechanical life of a tie, it is up to the engineers of this country to get busy and provide some way so as to save the ties mechanically.

I hope to live long enough to see the day when at least 99% of all the ties used in this country are treated, and if I was a member of the Commission of this country—of the Railroad Commission—I would insist that ties be treated, because we destroy our forests, we waste our time and we waste our money, and when the gentleman that addressed the convention at our last meeting said you could save $100,000,000 a year if your ties and timber were treated, he was about 50% too low (applause).

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MR. GEO. E. REX: Gentlemen, the Committee very kindly gave me an invitation to show some slides in connection with Mr. Waterman's talk, but at the time that the invitation was issued I did not expect it would be possible for me to be here. I therefore had to refuse, and it was only at the last moment I found it possible to come. I had no chance to prepare any talk or assemble my slides in the right shape, and have only brought a few along in my pocket to show you one or two things for a reason that just came to my notice.

I happen to be a member of a committee of the American Railway Engineering Association, and we had some new members. They were not treating men, but they were prominent engineers—Engineers of Maintenance of Way—the men that we want to reach, the men we want to be able to convince what we are able to do with timber preservation. One of those gentlemen was asking for information, and, in telling his experience, said this: "When we rebuilt a piece of line a number of years back, we decided to use treated ties."

Up to this time the road never used treated ties. They bought and put in, out of face, red-oak zinc-treated ties. He happened to be on the piece of track during construction, maintained the track afterwards, and kept a perfect record. He got eleven full years' life from those Burnettized red-oak ties, with which he was satisfied.

Four years later, in building some other tracks, these ties looked so good, they decided to do the same thing. They again bought from the same plant, under the same specifications, and the same conditions, another bunch of ties—red oak, Burnettized. He was in a position to see when they were put in, and knew absolutely from a perfect record of the track.

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He got 4 years' life out of those ties, and the thing he asked us, and he wanted to know was the why of this failure. To him there was absolutely no reason; he had no explanation; it was Greek to him. He did not know why, in buying on the same basis, and buying the same ties, and getting such excellent results with one lot, and buying the second lot of ties under exactly the same conditions, and getting inferior results.

That road practically ceased the purchase of treated ties, and that road is almost 6,000 miles long.

The other gentleman purchased, just a few years back, several hundred thousand loblolly creosoted ties. He went to the trouble of putting in screw spikes, and was supposed to get excellent results; had every reason to expect excellent results. In four years' time, he told us, he could take those spikes and pull them out with his hands. The statement that he made to us was that loblolly ties were not worth using in track construction. I just want to show you the slide, and I wish I might have brought along the two gentlemen, so they could have told their experience. I just want to show you these slides, not that they are anything new, but to help you realize that those are the gentlemen we have to convince, and we have to preach, (as Mr. Water-

Conditions that Cause Ties to Deteriorate.

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man says), in season and out of season to convince such gentlemen as that, that their methods were wrong, and not the treatment. There is the reason for the 4-year ties.

The next four or five pictures—there is nothing new about these, but this is the condition under which those ties were taken care of, that caused the man to get 4 years' life out of his ties, where he could just as well have had 15.

The only reason he did not get more than 11 years out of the other lot of ties was because they went through the vicissitudes of a construction track, and had no mechanical protection, and were very badly abused.

These are pictures similar to what Mr. Waterman showed, but they are actual conditions. They are seen in numbers of tie yards. That is water, fungus, every condition possible, absolutely every condition conducive to decay in and around seasoning material.

Result of Treating a Rotten Tie.

There is an example of a creosoted tie. It was in the track 14 months. This tie was passed by two first-class inspectors, men thoroughly familiar with pines and thoroughly familiar with treatment, and there was absolutely no sign on the outside of this tie to show that it was not first-class. It was treated and put into the track, and in 14 months came out in the condition you saw in the picture before; that is, it broke through under the rail. There was absolutely no

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sign but what it was all right, until it broke through under the rail and sawing a cross-section this is the condition we find. Now, this tie was treated with creosote, and, as I said, there was no sign, nothing that would tell a man what the interior condition of that tie was, and yet in 14 months this is its condition, and this is the reason why the second man got 4 years' life out of loblolly ties, and is convinced in his own mind that loblolly ties are a failure.

Now this is a picture of a loblolly pine tie that was cut in July this year. It is not a single example, as I will tell you later. We have had probably as good a seasoning year this year in the South as we have ever had, running along for months with no signs of decay, running all the ties through the boring and adzing machines, where the ends are cut off and there would not be 10 or 15 ties a day that would show any signs of decay. The first of November, without any apparent reason at all, a visual inspection of the ties would show the same condition as ties treated the month before, but we commenced to get ties in this condition, and we have been culling in a day's run from 250 to 1,000 ties, finding them in this condition, absolutely no sign on the outside of these ties, no fungus, nothing that would tell a man that the tie was decayed, on the outside, and yet the cut-off saws reveal this condition. This is simply one of 250 that we took. I just happened to be at the plant and counted this day's run, and there were 250 ties of

TIES IN TRACK ON A. T. & S. F. RAILWAY.

| Years | Total miles | Total Ties in in Track | Total Inserted for Renewals | Percentage of Total Ties Inserted to Total Ties in Track | Ties Inserted per mile |
|---|---|---|---|---|---|
| 1896 | 5,405 | 16,401,792 | 1,867,441 | 11.39 | 346 |
| 1897 | 5,339 | 16,181,440 | 1,611,509 | 9.96 | 302 |
| 1898 | 5,356 | 16,236,000 | 1,254,936 | 7.73 | 234 |
| 1899 | 6,171 | 18,585,952 | 1,290,282 | 6.94 | 209 |
| 1900 | 5,856 | 17,637,312 | 1,187,958 | 6.74 | 203 |
| 1901 | 5,900 | 17,759,456 | 1,075,041 | 6.05 | 182 |
| 1902 | 5,981 | 18,003,040 | 1,369,140 | 7.61 | 229 |
| 1903 | 6,135 | 18,524,352 | 1,470,286 | 7.94 | 240 |
| 1904 | 6,379 | 19,266,720 | 1,751,095 | 9.09 | 275 |
| 1905 | 6,989 | 21,164,932 | 1,869,233 | 8.83 | 267 |
| 1906 | 7,467 | 22,693,360 | 1,159,219 | 5.11 | 155 |
| 1907 | 7,427 | 22,522,324 | 2,067,651 | 9.18 | 278 |
| 1908 | 7,712 | 23,355,824 | 2,304,347 | 9.87 | 299 |
| 1909 | 8,041 | 24,391,488 | 2,355,540 | 9.66 | 293 |
| 1910 | 8,563 | 27,294,336 | 2,352,184 | 8.62 | 275 |
| 1911 | 8,872 | 28,270,420 | 2,335,796 | 8.26 | 263 |
| 1912 | 9,043 | 28,810,592 | 2,074,492 | 7.20 | 229 |
| 1913 | 9,168 | 29,208,992 | 1,818,205 | 6.22 | 198 |
| 1914 | 9,568 | 30,481,120 | 1,714,102 | 5.62 | 179 |
| 1915 | 9,552 | 30,422,416 | 1,879,897 | 6.18 | 197 |

similar condition to this that were thrown out in that one day's run. This is another. Now, men, there is absolutely no way for a man to tell this condition, except as revealed by a fresh cut, and until we get

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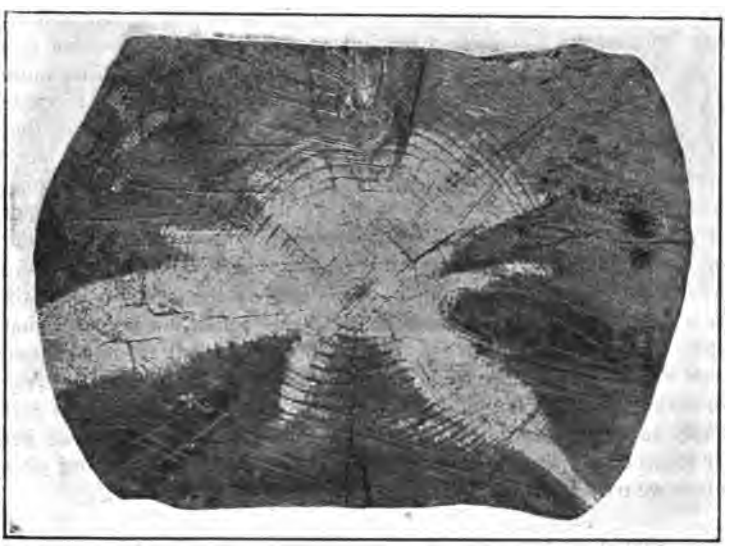
to a point where we can know what we are treating, we can expect to be told, like the gentleman told us, that the loblolly ties were no good. This is the answer that I would have to make to the man who said the loblolly ties were no good.

This is a Santa Fe tie renewal statement for a period of 20 years. You have all seen this table in the paper; so it is nothing new, but when I tell you that 50% of the Santa Fe ties are loblolly, and we are getting, as you see in the last column (1915), an average of 197 ties renewed per mile of track, it means more than 15 years. Do you suppose that that gentleman would have any trouble convincing me that loblolly ties were no good? You cannot put that kind of a thing across when you have an absolute record of the renewals on a large mileage of track as we have and as numerous other railroads here have.



Effect of Improper Barking on Treatment of Ties.

This is simply a picture showing the results of improper barking of ties, and what we can expect in the way of treatment if we do not take proper care to clean ties off—lack of penetration and the sapwood left unprotected. The ties are going to decay.

This is simply a picture of the improper use of creosoted material. The chief engineer has gone to the trouble of making a built-up whistling post, in order to get a creosoted base, which will not decay, and yet the man has taken a creosoted stick and sawed it in two, and left the exposed heartwood turned up to the sun and rain, an ideal

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condition for all the decay that is going. It would have been a great deal better if he had thrown his money away than to have put it into treatment for that stick, if he was going to use it in this manner. It is a small structure, but it simply illustrates what is being done every day in sawing creosoted material after treatment.

This is another example of piles improperly treated. These piles were treated under our specifications, green, with a 10-lb. treatment. I happened to be out inspecting track in 1907 when the man who was driving this pile into a ballast-deck bridge, a bridge in which, unless we can get 30 years' life, we are making a mistake, and we can get 30 years' life if we will do the work right, it just so happened that I came along and immediately had him saw off this sample, which I have in my office, and I wrote a report to the effect that if this was the kind of creosoted material that we were going to put in our ballast-deck bridges, we better close up our treating plants, because we certainly would never get anything like a life expected, very little more life than the untreated material. This material commenced to come out of these ballast-deck bridges in 1910 and 1912, and our people that are responsible for the spending of our money began to get very much alarmed, and several of our men that have the influence in shaping our policy were ready to throw up their hands and say, "We will quit the creosote business for piling; absolutely quit the business," and had it not been for this particular sample that I showed you in the picture before—and this sample goes back to the same bridge six years later, and this is the condition of them—had it not been for that report, which went on record 6 years before, to tell them what we could expect out of this material, we would very likely have quit the creosoting of piles, and thus made a very serious mistake. It is just simply to show that unless we do the work carefully, unless we get our sapwood all penetrated, unless we get the moisture out of our piles before we treat them, we are making a mistake.

It should be the duty of every treating man to absolutely insist not only that his treatment be done in the right manner, but he should be furnished plenty of oil to see that he gets every bit of his sapwood penetrated, and if he does not, this will be the result. We took out over 6,000 sticks in 6 years of this kind of material out of ballast-deck bridges, and yet to anybody that has followed the creosoting business, as we do, those of us that are interested in it and are following it day by day, there is absolutely no question in any man's mind but that he can get 30 years' life out of his piling. He can figure on 30 years' life if he will get proper penetration with the proper kind of preservative.

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This is simply a lot of these creosoted piles removed after 6 years' life. This is the condition they are in. That is all due to lack of penetration, and the man that treated this material was not responsible, mind you, or anywhere near entirely responsible. He was given a specification that allowed him to put in 10 pounds of oil in such piles as that (three-fourths sapwood). We all know that 10 pounds under

Result of Insufficient Treatment of Piles.

that condition will not penetrate the sapwood. He was bidding in competitive business; he had to take the contract, and if he had not treated it, somebody else would have treated it. The road is responsible. The road that will allow that kind of a thing to go is responsible for that condition.

This is a picture on the improper use of creosoted material—a picture of a drain box. This is the top of a creosoted drain box that has been in the ground ten years, and it is typical of what you may expect if you saw creosoted material and put it into the ground after treatment. Every block in the top of that box that is decayed is a sawed block. Every block that was not sawed is in absolutely perfect condition. I have two or three samples here in my hand that I am going to show you, after I show the other pictures, to show the end penetration, to show that the seal has not been broken and that the block is in perfect condition, is good for an indefinite life, and this is the condition and yet, some say creosoted material is no good, that we

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Result of Improper use of Treated Timber.

will cut out the creosoted material in this structure and that, because it is no good. It is no good, because the man has abused it, and not because the treatment is not right.

Here is an example of a drain box which was reported as a failure, a creosoted box, in 1914. The chief engineer received a form from the division engineer for authority to put in a new drain box at this particular location. The old box, the records showed, had only been in 11 years. He asked me at once why we were taking out a creosoted drain box in 11 years, and I just happened to be able to go personally to see that particular box. And when I got on the ground I found that the box had originally been put in on the main line 11 years before, was untreated white oak box, and had given, as you will all admit, quite unusual life in that condition. Three years before this they had extended the siding, the passing track, along past this box and put in what was supposed to be a creosoted box under the passing track. I went out to the end of this box and found these creosoted planks and the end of the box beyond the passing track. I was pleased to see the condition of the box. At this time I had not known how long this creosoted box had been put in at all, but in getting down and looking

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through the box I was surprised and flabbergasted to see hanging down, in the center of the box, about 8 ft. from the end, great quantities of fungi. I could not understand it. I could not realize it. I could not feel that it was possible that this fungus could be growing in this box. The end planks were excellent, and the side plank all along you could see was in excellent shape, and yet, back there, only 8 ft. back from the end, great quantities of fungi were growing. I immediately got the section gang to excavate around that box to find out what was the matter. When I got down to the box, this is the condition I found, just exactly, and it was so important that I right then took the box and sawed this section out, and rebuilt the box in the office with three pieces of boards, just as I found it there in the ground. What the man did was this: He sawed every creosoted piece that went into that box after it was treated. He did not have quite enough boards to come together to complete this top, so he went out and picked up a 2-in. plank and filled in this space, as you see. One was not thick enough, so he put a second one on, and these two untreated pieces in three years' time were in the condition as you see, and not only that, but they had infected the sawed ends of the creosoted plank.

Now, men, what can we expect if we are going to let our material be mutilated in this manner? That box, and just such examples as that, gives the man that does not know the creosoting game a feeling that there is some bunk; there is something in the treating game that is bunk. It is our duty—I feel it is the duty of every one of us to follow up these things to the end in order to stop this kind of work.

This is simply a picture of our modern boring and adzing plants, in which we put through all our ties. The ties are put on to a conveyor on the other side and passed through these cut-off saws; the second machine adzes them; the third machine bores them, and the fourth stamps these ties, as you saw, on the ends. It might be of interest to you to say that we have five of these plants in operation, and one plant we are operating night and day, turning out approximately 11,000 ties on four shifts. Every tie going through our big plant there is put through these machines.

We have a method of preventing the destruction of our ties by mechanical wear, as this picture shows. Mr. Waterman showed you some excellent examples of what mechanical wear is doing, and we are at a point now where anybody that has followed the treating business is absolutely convinced and can convince anybody that will give him time to talk to him that we have solved the treating problem, and a man can be absolutely assured, if he will do the work right and pay the money for it, and the work is done honestly, he can be absolutely assured of getting more physical life out of the ties than we can get mechanically. I do not agree with Mr. Waterman. It is not up

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to the mechanical engineer to get mechanical protection but it is up to us to force mechanical protection, and we can only do it by showing and convincing these people that our first-class creosoted material and zinc-treated material is being removed on account of the mechanical wear, and not on account of decay. We are finding that large numbers of our ties are now coming out on account of mechanical destruction in and around the spike, where the spike has destroyed the fiber until it will no longer hold the spike where the rail is cut, and they are mechanically destroyed.

This is simply one of the methods we have taken to get more mechanical life out of our ties with the wood dowel. We are now putting in a couple hundred thousand dowels in some of our softer woods, like the redwood and loblolly pine. It takes money, but if we could do this we could avoid mechanical destruction of these soft-woods. There is absolutely no reason why we should not be getting twenty-five years, just as well as twelve or fifteen years if we would do this in our softer woods. The redwood ties, for instance, as you know, we do not treat, but we are using redwood ties largely on our coast lines. Those ties are just about half as strong as the longleaf or the Douglas fir ties. Those ties (the most of them) will not decay. There is no reason why we cannot get fifteen or sixteen years out of those ties if we can protect them from mechanical wear, and this is the method we have taken to start to protect our redwood and our Douglas fir and our loblolly pine ties from mechanical wear. Here is a sample of a pile treated in 1875 and removed in 1912, when the causeway was put across Galveston Bay. The only reason I am showing this picture, which is the air section of a pile in that climate, which you all know is as severe as any climate in the country, is simply to show you if the material is well creosoted there is no such thing as decay.

Treated Tie in Track 26 Years.

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The next is simply another picture of the same kind, in which the tie has been in the track 26 years. This is a Baltic fir tie. It is the old French tie, as all of you know. It has been in the track 26 years—ten years without dowels and 16 years after having been dowelled—before the tie was removed for inspection only. It is simply another example of what you can expect if you will properly treat them —26 years' life. There is no reason why that tie will not give 10 years' more service. The interesting feature of this tie particularly is the small amount of penetration that is necessary on the heartside of these ties. For that section that treated area is not broken, so that the moisture and dampness and spores and everything has to pass through the treated area. As long as you can maintain that area your heartwood will not decay, if you have all your sapwood penetrated and maintain a seal of creosoted material. This tie is not creosoted at the bottom more than a ¼ in., and yet it is perfectly sound. It might be of interest to say that the later developments in the Douglas fir tie, which we all know is rather hard to treat, have demonstrated that we can control the penetration in Douglas fir by the new mechanical method. With that and boring and adzing those ties, there is absolutely no reason in the world why our Douglas fir tie is not going to come in and give us just as good ties as our longleaf creosoted ties.

These, gentlemen, are all the pictures I have here. If you will turn on the light a moment, I just want to show you what I have here. Here is a sample of that piece of drain box. There is the condition of the ends of every plank that was sawed. Here is the condition of everyone, or the original ends, of the plank. Now, men, there is not a man in the house that can afford to see and allow a single stick of creosoted material sawed after treatment and not make a kick about it. If we are going to get results out of our treating, we must see that it is properly handled mechanically. This is important, because you are all going to have trouble with failures if you do not follow this stuff up (applause).

THE PRESIDENT: Gentlemen, I know you are fond of moving pictures. We prepared some for this afternoon, but the machine is not working out very well. We made an application for a license the other day, and we turned it over to a man whom we thought would take care of it and have the license on hand. He evidently turned the application over to another man and the license was taken out, but has gone astray. It is not here; and they refuse to turn on the current until the license is here. It will be here in a very short time, but we have no assurance of just how long it will take. Our time is growing short, and I think we would better go ahead with another part of our program until we have this license here and can go ahead with the moving pictures.

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MR. J. H. WATERMAN: Mr. President, I would move you that we go ahead, if you need a motion, and when the license comes we can turn out the lights. We can give ten or twelve minutes to the moving pictures almost any time, if that is satisfactory to everybody. I know we are disappointed.

THE PRESIDENT: Is Mr. Teesdale in the room? We have two committee reports to be presented this afternoon, and if Mr. Teesdale is not ready, we have a short paper on our program, "The Grouping of Ties for Treatment," by Mr. C. P. Winslow, which I think we will have now. Mr. Winslow is not here, but Mr. Hunt will give us this paper.

MR. GEO. M. HUNT: Mr. Chairman, the paper is very short, and I think I will read it all in order to get it before the convention.

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## THE GROUPING OF TIES FOR TREATMENT.

By Carlile P. Winslow.

*Assistant Director, Forest Products Laboratory, Madison, Wis.*

At the last annual meeting of the Association the writer in conjunction with Mr. Newlin, presented a discussion of Mr. Van Meter's paper on "Woods Suitable for Cross-Ties." This paper and discussion presented at some length a basis of classification of woods used for cross-ties according to their mechanical properties, and included a tabulated classification of a wide number of species. Many of these woods, due to their susceptibility to decay, are either not well suited for ties without a preservative treatment, or require a preservative treatment in order to give results of greatest economy. Some data and discussion to serve as a basis of classification of these woods according to their relative ease of treatment should, therefore, round out the situation.

The subject is one which has received considerable attention and discussion at past meetings of the Association. In 1910 Mr. Angier contributed an interesting presentation of the matter, and in 1911 attention was again called to it by Mr. Goltra's exhaustive paper and the resulting discussion. While there has been little further direct discussion of the subject at subsequent meetings, it has from time to time been touched upon more or less directly in connection with other problems of the wood-preserving industry.

In its broader aspects, the proper grouping of ties for treatment is dependent upon a variety of variables. Aside from the inherent variations of individual species, we must contend with variations in moisture content, variations in the proportion of heartwood and sap-

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wood, variations in the form of the ties, in the character of treatment desired, and in the character or kind of preservative used. According to the combination of such variables that may exist at a given plant at a given period or season, so will be determined the grouping best suited for its needs. But the underlying and governing factors are the inherent differences in susceptibility to treatment of the individual species.

It was to secure a comparison of this nature that a series of tests were conducted at the Forest Products Laboratory under the immediate direction of Mr. Teesdale, who has given much assistance in the preparation of this paper. He has published a detailed account of the experiments with coniferous woods in Bulletin 101 of the Department of Agriculture. Similar tests have since been carried on with hardwoods, and a brief description of the methods used will apply to the entire series.

Air-dry specimens were used throughout. So far as practicable both heartwood and sapwood were included in the tests. Coal-tar creosote was uniformly used, and two classes of treatments were included. One involved an application of the preservative for a given time, through a pipe applied to a hole bored at the center of the specimen, with the subsequent exact measuring of the extent of the penetration. The other method involved impregnation in a small cylinder for a specified time, with a subsequent determination of absorption and penetration. Throughout the tests, the temperature of preservative, intensity of pressure, time of application, etc., were kept constant, and in fact, all possible precautions were taken to eliminate all variables save one, namely, the species.

The results are shown in Fig. 1 and 2 where the data for the conifers and hardwoods are separately presented. The results with both heartwood and sapwood are included in so far as both types of specimens were used. It is of special interest to note the results with chestnut oak. This species has always been classed both botanically and commercially as a white oak, but was found to treat with about the same susceptibility as red oak. In connection with the Douglas fir, it is also to be noted that it was of the mountain variety; other tests with this species from both the mountain and coast regions have shown the former much more resistant to impregnation with creosote than the latter.

The extent to which the results as presented above are applicable to an actual grouping of ties for treatment is the next question of importance. It should first be kept clearly in mind that any general grouping based entirely on the species is entirely impractical. The striking difference in the susceptibility to treatment of the heartwood

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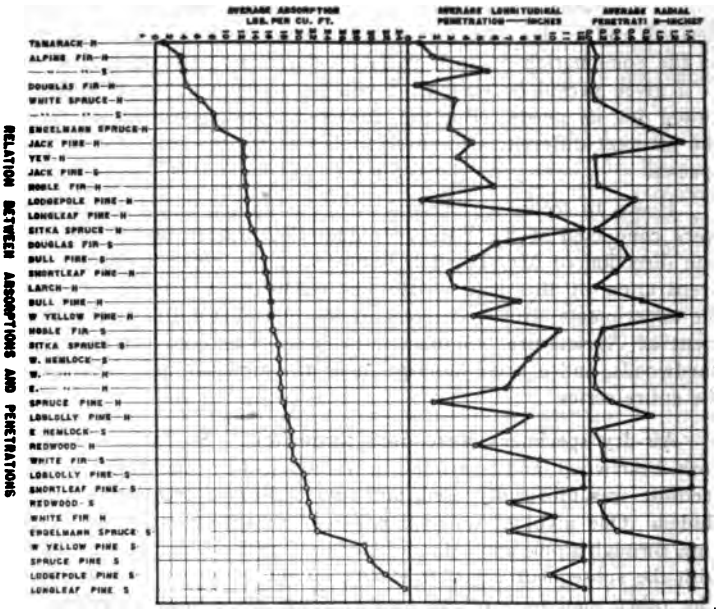


Fig. 1.—Conifers.

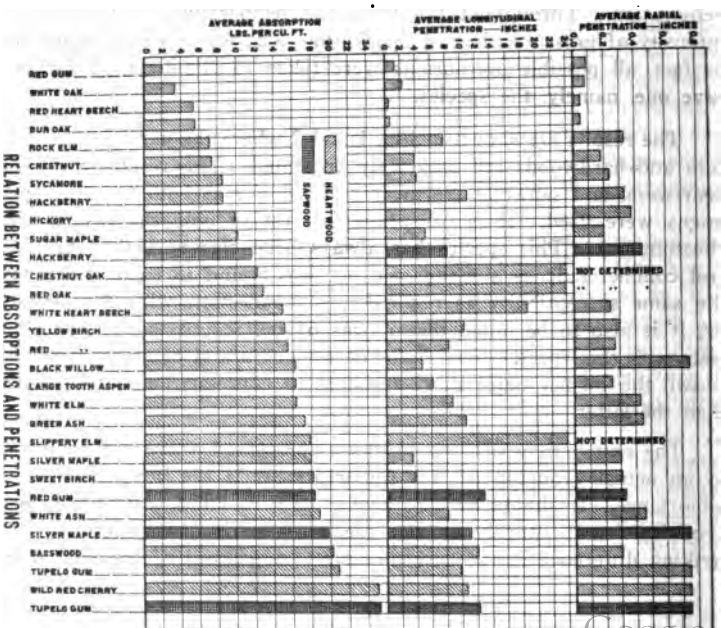


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Fig. 2.—Hardwoods.

and sapwood of nearly all species is so generally recognized that it scarcely needs comment; the innumerable combinations of relative proportions of heart and sap which may exist in individual ties is equally well-known. As previously indicated, therefore, the problem is of a dual nature: first, a consideration of the relative ease of treatment of the sapwood and heartwood of different species, and secondly, a classification according to the form of ties it may be desired to group for treatment at a given time and place.

To further illustrate the point, Fig. 3 is presented. It shows a number of representative types of ties. Consider for a moment ties "A" and "(A)" as there illustrated. Even if of the same species, it cannot be doubted that in the majority of cases two such ties would treat with greater dissimilarity than two ties similar to either "A" or "(A)" but of different species. With ties such as "B" and "E," the complications would be even greater, since the proportion of heart and sap in each case might vary over a wide range.

In order to present even the most general grouping of ties for treatment, some classification must, therefore, be adopted. Innumerable classifications might, of course, be drafted, but the following, which is the same as that recommended last year for structural timber by your Committee on Specifications for the Purchase and Preservation of Treatable Timber, will serve the purpose:

Class 1. Ties showing no heart on any face.
" 2. Ties showing no sap on any face.
" 3. Heart face ties with not less than 80% heartwood.
" 4. Heart face ties with not over 20% heartwood.
" 5. Other ties not falling in any of the foregoing classes.

To accompany the foregoing classification, the following grouping, based primarily on the previously discussed data, is presented as generally indicative of the relative ease of treatment of the different species used for ties. The species in each group are listed alphabetically, and the groups are listed in order of ease of treatment:

Hardwoods.

*Group 1.—Sapwood.*

All species listed below are reasonably susceptible to treatment.

*Group 2.—Heartwood.*

Ash, white.
Ash, green.
Basswood.
Beech (white heart).
Birch.

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*Group 2.—Heartwood.—(Continued.)*

Cherry, wild.
Elm, slippery.
Elm, white.
Gum, tupelo.
Oak, red.
Oak, chestnut.

*Group 3.—Heartwood.*

Aspen, largetooth.
Elm, rock.
Hickory, mockernut.
Maple, silver.
Maple, sugar.
Sycamore.

*Group 4.—Heartwood.*

Beech, red heart.
Chestnut.
Oak, white.
Oak, burr.
Gum, red.

Softwoods.

*Group 1.—Sapwood.*

All species listed below easy to impregnate with the exception of the following:

Alpine fir, white fir, white spruce, hemlock (eastern and western). These are considered further in Group 4 below:

*Group 2.—Heartwood.*

Pine, jack.
Pine, loblolly.
Pine, longleaf.
Pine, Norway.
Pine, shortleaf.
Pine, spruce.
Pine, western yellow.

*Group 3.—Heartwood.*[1]

Pine, lodgepole.
Fir, Douglas (coast).
Spruce, Englemann.

*Group 4.—Heartwood.*

Cedar.
Cypress.
*Fir, Alpine.
Fir, Douglas (mountain).
*Fir, white.

[1]Some question as to whether the lodgepole pine and Englemann spruce should not be included in Group 2 and the Douglas fir in Group 4.

*Includes sapwood.

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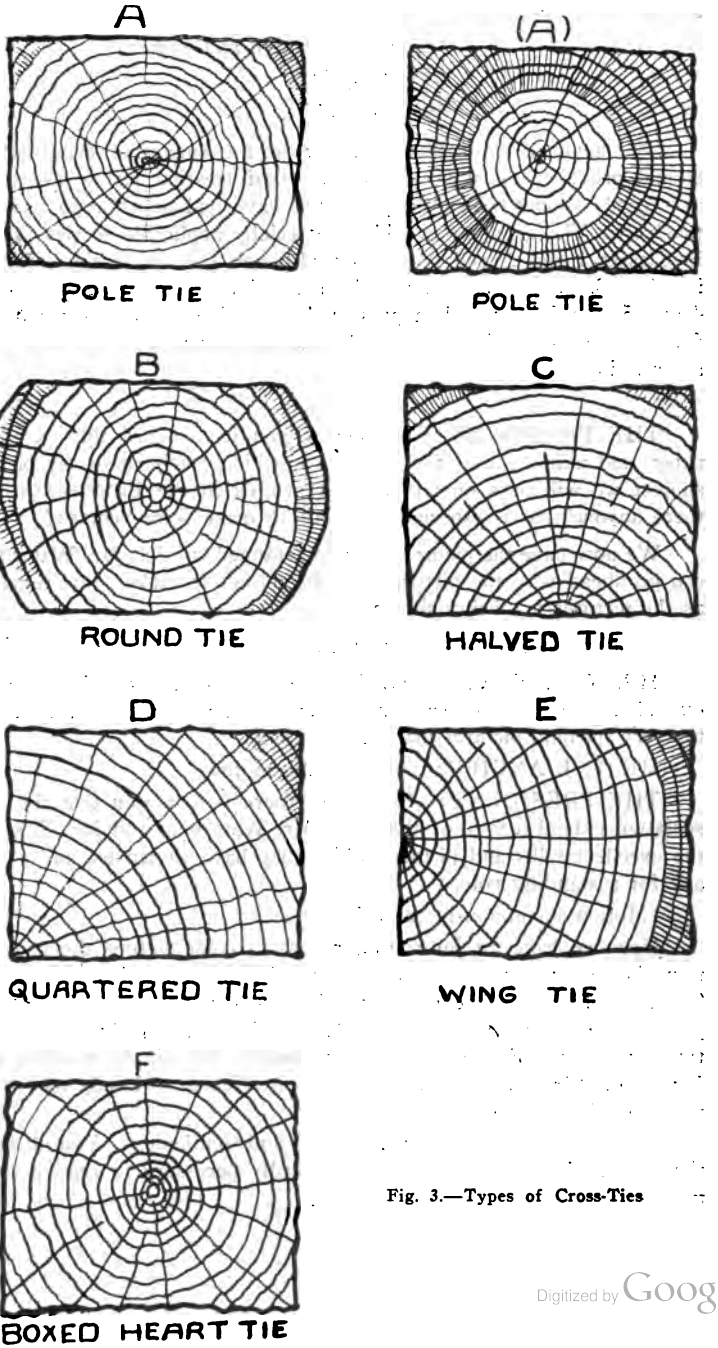


Fig. 3.—Types of Cross-Ties

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*Group 4.—Heartwood.—(Continued.)*

**Hemlock, eastern and western.
Larch, western.
Tamarack.
**Spruce, white.

The application of this grouping to the suggested classification should prove of assistance to operators of treating plants, especially as regards species which they may not have had occasion to use extensively. The grouping would be especially applicable to ties falling in Classes 1 and 2, and reasonably, although less so, to those falling in Class 3. Predictions cannot be made for these falling in Classes 4 and 5, but from the data presented, some idea as to their capacity for treatment could be determined by a consideration of the heart and sap relationship.

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THE PRESIDENT: Gentlemen, you have heard this excellent paper, and unless some of you have something pertinent to say on the subject we will pass on and have it printed in the PROCEEDINGS. Is there anyone that is especially anxious to make some remark?

We now have the picture machine arranged, so that Mr. Waterman can go ahead with the pictures, and he wishes to make some remarks as the pictures are being shown.

(The moving pictures were then shown.)

MR. NELSON C. BROWN: I move that a vote of thanks be extended from the Association to Mr. Waterman and Mr. Rex for the very splendid pictures that we have seen.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Gentlemen, there is a motion that the Association extend a vote of thanks to Mr. Waterman and Mr. Rex for the excellent talks and pictures which they have shown us, and I will ask for a standing vote.

(Motion unanimously carried.)

Now we have an interesting report to come before the convention, the report of the Committee on the Purchase and Preservation of Treatable Timber. The members of the Committee are: Mr. A. R. Joyce, Chairman; Mr. J. B. Card, Mr. O. P. M. Goss, Mr. F. R. Martin, Mr. George E. Rex, Mr. Lowry Smith, Mr. E. A. Sterling and Mr. C. P. Winslow. I would like these gentlemen to kindly take their places on the platform.

MR. A. R. JOYCE: Mr. President and Gentlemen: You all have the report of this Committee. It is hardly necessary to read it now.

**No real distinction between heart and sap.

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You will note that the portions of the report printed in italic type are recommended by the Committee for inclusion in the MANUAL. If it is satisfactory to the members present we will read such portions which are printed in italic type and move them for adoption. The first portion to be so printed reads as follows:

*Whenever conditions will permit, thoroughly air season all structural timber, track ties, piles and other materials before treatment. So far as practical arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity.*

MR. A. R. JOYCE: I move you that this paragraph be adopted by the Association.

MR. E. W. BRIGHT: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. Any remarks? All those in favor of adopting this paragraph signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: The next section reads as follows:

*The seasoning yard should be in the open where the prevailing winds will strike it freely; should not be in a low and humid situation of any kind if it can be avoided; should have good drainage; and should be kept free from weeds and grass and decaying wood material.*

*All outer bark should be removed before treatment, and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should over 10% or strips over 1 in. wide and 6 ins. long be left.*

*When there is not sufficient time for proper air seasoning, or, in the case of piling and large dimension timbers which will not air season successfully throughout without deterioration, artificial seasoning by steaming or boiling before treatment must be resorted to.*

MR. A. R. JOYCE: I move you, Mr. President, that these paragraphs be adopted as read.

MR. E. W. BRIGHT: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of this paragraph signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: On page 415 we recommend as follows:

*In treating with creosote, it is recommended that a maximum injection of creosote sufficient to insure the penetration of all treatable wood be required. All of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated. This applies equally to full-cell and empty-cell treatments.*

*In treating with zinc chloride it is essential that all timber be treated to refusal.*

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I move you, Mr. President, these be adopted as read.

MR. F. W. CHERRINGTON: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of adopting this paragraph signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: On page 415:

*Wherever possible, all timber should be framed before treatment, and in lieu of this unimpregnated wood exposed by framing after treatment should be thoroughly painted with hot creosote.*

*To secure the best results it is necessary to protect treated material from mechanical abrasion both in handling and under service conditions.*

I move you, Mr. President, these be adopted as read.

MR. WALTER BUEHLER: I second the motion.

THE PRESIDENT: All those in favor of adopting these paragraphs will please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: At the top of page 416:

*A penetration of ½ in. on the heart faces may be recommended as a safe minimum on structures above ground.*

I move you this be adopted as read.

MR. NELSON C. BROWN: I second the motion.

THE PRESIDENT: All those in favor of adopting this paragraph please signify it by saying "aye"; contrary, "no." It is adopted.

MR. A. R. JOYCE: At the top of page 416:

*Where strength is required, not only the defects which might reduce the strength but also the quality as determined by density should be specified; but where strength is not an essential only the soundness of the timber and the sapwood requirements as determining penetrability need be considered.*

I move that this be adopted as read.

MR. F. W. CHERRINGTON: I second the motion.

THE PRESIDENT: All those in favor of adopting this paragraph please signify it by saying "aye"; contrary, "no." The motion is adopted.

MR. A. R. JOYCE: On page 421 under Piles:

I move this be adopted as read.

*Piles for use in salt water where ravages of marine borers are extremely severe: Specify not less than 2½ ins. of sapwood, nor more than 5 inches.*

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MR. WALTER BUEHLER: I second the motion.

THE PRESIDENT: All those in favor of adopting this paragraph please signify it by saying "aye"; contrary, "no." It is adopted.

MR. A. R. JOYCE: On page 421:

*Piles for use in salt water where ravages of marine borers are less severe than in Group 1: Specify not less than 1 in. sapwood, nor more than 3 inches.*

I move this be adopted as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Gentlemen, there are quite a number of these recommendations, and unless there are some objections raised, I do not see any reason why we should put the motion every time. We will have the motion made and seconded and declared adopted, unless there are some objections, if there is no opposition to this ruling. Are there any objections to this paragraph as read? If not, it is considered adopted.

MR. A. R. JOYCE: On page 421:

*Piles for use in fresh water or foundation work on land: No sapwood restrictions are necessary.*

I move the adoption of this paragraph as read.

MR. LOWRY SMITH: I second the motion.

THE PRESIDENT: Are there any remarks? If there are no objections this paragraph will be considered adopted.

MR. A. R. JOYCE: At the bottom of page 422:

*Support all piles on treated sill ties, and in all cases at least 6 ins. of air space should be allowed underneath. To allow proper air circulation, the alleys between the piles should extend in continuous lines across the seasoning yard and should be not less than 5 ft. in the working spaces and 1 ft. in other directions.*

*In a moist climate and under humid conditions, season all material in open piles, which will provide free circulation of air and exposure to the sun. Place a close slanting roof of ties over all piles. By open piles is meant the common 1x7, 1x8 or 7x2 piling system, or other arrangement which gives a minimum contact and the maximum of open spaces between the ties. Insist that the stringers be placed as near the end of the ties as possible, then in case of any defects from contact they will not fall upon the rail bearing. In arid climates with low humidity, season in close piles to prevent checking and warping.*

I move the adoption of these paragraphs as read.

MR. J. B. CARD: I second the motion.

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MR. O. C. STEINMAYER: I do not see what the intent of the Committee is when it says "5 ft. in the working space and 1 ft. in the other directions" in piling ties. Just what did the Committee have in mind?

MR. LOWRY SMITH: Why, I think what is meant there is the two systems of piling across the yard, either the continuous system or individual piles. By dividing by 1 ft. it means the space between the individual piles, not the tiers of ties. It is customary in some places to pile individual piles and in some to continuously pile them in one tier.

MR. O. C. STEINMAYER: It seems to me that 5 ft. is entirely too large a distance to make a minimum width of alley, because it would take entirely too much yard space, and I hardly think that amount of alley space is necessary where the ties are not piled excessively high. It is my idea that the necessary width of alley between piles is dependent upon the height to which the material is piled, to get the best seasoning conditions, and to avoid loss from excessive checking due to rapid seasoning. It seems advisable, therefore, that the minimum width of alley should be 3 ft., which will allow a person to get in between the piles and observe the conditions of the timber in piles during the seasoning period.

MR. F. J. ANGIER: Mr. President, I want to go on record as agreeing with Mr. Steinmayer on 3 ft. between piles. We have been piling ties for about 15 years and have never used more than 3 ft., and we find this ample, not only for seasoning, but for getting between to put in "S" irons and to do other work. I think it takes altogether too much room to make it 5 ft.

Also another sentence in the last paragraph, in which it says, "Place a close slanting roof of ties over all piles." This may be all right theoretically, but as a matter of fact it is not done and will not be done at a timber-treating plant that is handling millions of ties a year, and I do not see the necessity for it.

MR. E. H. BOWSER: I agree with Mr. Angier on that. I do not think you ought to roof the ties. What you prevent is the water getting into the middle of the pile. When you have that roof slope you get a great deal more water on one end of your pile of ties than the other, and those ends of the ties will decay much quicker and the seasoning conditions are very different from the other parts of the ties. I believe you ought to leave it open and not put the roof on. I think it is better without the roof, so the ties will season more evenly.

MR. F. J. ANGIER: Mr. President, if I am in order, I would like to make an amendment to the motion that in the first paragraph 5 ft. be changed to 3 ft., and in the second paragraph to omit that sentence reading, "Place a close slanting roof of ties over all piles."

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MR. E. H. BOWSER: I second the motion.

THE PRESIDENT: Are there any remarks on this amendment? If not, gentlemen, you have heard the amendment. All those in favor please signify it by saying "aye"; contrary, "no." The amendment is carried. As the motion now stands amended, are there any further remarks? If not, all those in favor——

MR. C. E. GOSLINE: Would it not be a good idea to suggest there just what is meant by "the other way"; to state between what that 5-ft. alley or the 3-ft. alley is? As it is now we do not know whether it is parallel or at right angles to the track.

MR. O. C. STEINMAYER: As it is now, the 3 ft. of alley is the minimum width. It does not make any difference what direction it is; it is just an alley of 3 ft. I do not think that would be misinterpreted.

MR. LOWRY SMITH: It is a continuous arrangement across the yard. What does "across the yard" mean? It does not mean lengthwise.

MR. O. C. STEINMAYER: You have a minimum distance that you must pile your ties from standard gauge tracks. No use for us specifying that because it is specified by other authority.

THE PRESIDENT: Are there any further remarks? Are you ready for the question? All those in favor of adopting this paragraph as read, with the amendments which have just been adopted, will please signify it by saying "aye"; contrary, "no." The paragraph as amended is adopted.

MR. A. R. JOYCE: In the last paragraph on page 422 we have the following:

*Both gum and beech should be seasoned only in wide open piles and watched very carefully for dry rot.*

I move the adoption of this as read.

MR. F. J. ANGIER: I second it.

THE PRESIDENT: Any remarks? This paragraph as read is considered adopted.

MR. A. R. JOYCE: At the beginning of the third paragraph on page 423 we have the following:

*Ties and timbers which have a tendency to check should be protected with "S" irons, or other devices.*

I move the adoption of this as read.

MR. F. J. ANGIER: I second it.

THE PRESIDENT: Any remarks?

MR. O. C. STEINMAYER: Mr. President, what is the idea of specifying the kind of rot that you should guard against in beech and

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gum? The Committee's recommendation reads: "Both gum and beech should be seasoned only in wide open piles and watched very carefully for dry rot?" What is the idea of specifying the kind of rot?

MR. A. R. JOYCE: Mr. President, we are perfectly willing to take the "dry" out of the rot.

MR. O. C. STEINMAYER: Why not say "decay" for "rot"?

THE PRESIDENT: Are there any remarks on the sentence which has just been read regarding "S" irons? If not, this will be considered adopted.

MR. A. R. JOYCE: In the middle of the third paragraph on page 423 we have this sentence:

*All ties should be bored and adzed before treatment.*

I move the adoption of this as read.

MR. GEO. E. REX: I second the motion.

MR. E. H. BOWSER: I would suggest that you put in there, "if the conditions justify it."

MR. O. C. STEINMAYER: Mr. President, why not add "as far as practicable"? There are a great many ties produced on rivers and streams that have nails driven in them to aid in the rafting and driving of those ties. I do not think it would be feasible to run such ties through a tie adzing and boring machine. If the clause read, "as far as practicable," that objection would be overcome. There are several million ties received from rivers which would have these nails in them, so this is something worth while.

MR. C. E. GOSLINE: Mr. President, the way to overcome that would be to educate your tie-rafting people to nail your strips closer to the ends of the ties.

MR. E. H. BOWSER: What I have reference to, if you have long stretches on your road, where the rail changes every two or three miles, it is impractical to ship bored ties to the section foreman, because you will never get them in the right place. You will have to have considerable stretches of the same kind of rail base before you can do the boring, unless you have special tie-plates that will hold any rail with the same spacing of spikes.

MR. A. R. JOYCE: The sentence as framed here does not say, "All ties must be under penalty," it says, "All ties should be."

MR. O. C. STEINMAYER: Why not put in there, "so far as practicable all ties should be adzed and bored before treatment"?

MR. A. R. JOYCE: The qualifications do not make any difference.

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MR. O. C. STEINMAYER: I cannot understand how you can run some rafted ties through tie adzing and boring machines. You know, Mr. Smith, you would have to explain it in a way. I have found you can't get contractors to handle it.

MR. A. R. JOYCE: That is the point.

MR. GEO. E. REX: I would like to say that we have had that experience, and I think all of you agree with me that there is no tie that needs that boring and adzing any worse than those rafted ties, those ties that have laid in that river until we often do not know how long they have been out, and there is no way of telling, and under bad conditions, and those are the ties of all ties that do need the boring and adzing. While it is true that there are some nails, and you run your bits and saws through them, but, as Mr. Gosline suggested, they should be educated to get away from them just the same as we find it difficult to get our contractors to mark our ties for inspection, but we do not get away from it, we do not let them get away from it because it is a trouble. I think they should be educated to put their nails in the right place, and not put them where you will ruin your boring and adzing machine.

MR. E. A. STERLING: Mr. President, the Committee, as I understand it, was simply stating a broad principle. It does not mean you must do that, or anything of the kind. The need certainly exists in spite of the fact that there may be local conditions or circumstances which would prevent doing it. It is simply the idea of the Committee to state this as a principle. I think we all agree that as a principle it is sound.

THE PRESIDENT: Any further remarks? If not, there are no amendments to the motion, and therefore I will put the motion. All those in favor of adopting this sentence as read will please signify it by saying "aye"; opposed, "no." The motion is carried.

MR. A. R. JOYCE: A little farther down in the same paragraph on page 423, we have this sentence:

> *If possible, all timbers should be framed before treatment.*

I move the adoption of this sentence as read.

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: Any objections?

MR. C. E. GOSLINE: I think the "if possible" should be cut out of that.

MR. A. R. JOYCE: We will cut that out.

THE PRESIDENT: If there are no further objections, the motion will be considered as carried.

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MR. A. R. JOYCE: The second paragraph occurring on page 423:

*Oak ties should be given a minimum of eight months seasoning, and should preferably be seasoned 12 months; yellow pine if seasoned in the south 4 to 6 months; hemlock, tamarack and jack pine 12 months; gum, beech, birch, and hard maple from 4 to 6 months.*

I move the adoption of this as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Are there any objections?

MR. O. C. STEINMAYER: I can imagine the condition of a red oak tie that was cut in the month of November and only 8 months afterward an attempt was made to treat it. I do not think it would be very well treated. Would it not improve this paragraph to say "8 seasoning months"? There is little seasoning occurring in the months of November, December, January, February, March.

MR. LOWRY SMITH: It would not be seasoning then, would it?

MR. O. C. STEINMAYER: It is seasoning more or less, but it would not be time enough for treatment.

MR. H. M. ROLLINS: Mr. President, I would like to know what the Committee means to include under the phrase "southern yellow pine"? Whether it means to include all southern yellow pines? Because, if it does, I think the period of four to six months should be modified to some extent. I would suggest that that be cut to 90 days on loblolly pine.

MR. J. H. WATERMAN: Mr. Chairman, is 4 months enough for beech, birch and maple? It looks to me as though beech, birch and maple are about as hard to season as red oak, especially hard maple. I am with the Committee, I will vote for whatever it says is the proper thing here, but I would like to call attention to that.

MR. WALTER BUEHLER: Mr. President, I think the difficulty of trying to season beech, for instance, longer than say 4 months, that coming from Kentucky, Tennessee or any of the southern points, is that the sapwood begins to rot if you hold it longer than that period. That has been our experience in a number of cases, that when ties got to us treated we in some cases found that the sapwood of beech had already rotted. It probably had been held at the seasoning yard too long. You do not get very much treatment into the heart of a red beech tie, and if you can get the sapwood seasoned, and I think you can get it seasoned in 4 months, I believe that is about as long as it is advisable to hold the wood for seasoning. In the case of beech, and I believe maple, that would be somewhat the same proposition.

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MR. J. H. WATERMAN: Mr. President, you have had more experience than any man in the world on that. What is your judgment?

THE PRESIDENT: On beech, birch and maple?

MR. J. H. WATERMAN: Yes.

THE PRESIDENT: My idea is that they should be seasoned 6 to 8 months.

MR. G. S. HARDEN: Mr. President, I want to agree with you on that. The most of our ties are beech and maple and it has been our experience that they require at least 6 months' seasoning. They have to be watched very carefully for indications of rot during this period.

MR. NELSON C. BROWN: Mr. President, I would like to ask the Committee if any data were secured on other forms of ties, such as fir and chestnut, which are used in very large quantities? I would like to know if any data were secured on those species in particular.

MR. L. T. ERICSON: Mr. President, I believe the Committee is wrong in trying to establish a uniform period of seasoning for ties in various parts of the country where the conditions are so dissimilar as they are in this country. I think it is preferable to determine whether the tie is ready to treat by making laboratory tests of the borings to determine the moisture content. In connection with seasoning, the length of time should always be governed largely by making tests of borings for moisture content, and it should be remembered that the moisture content will vary in different species of wood; so that while 20% of moisture content in pine will probably be correct in one locality, in that same locality perhaps oak cannot be air-seasoned to less than 30% moisture content.

THE MEMBERS: Question, question.

THE PRESIDENT: Gentlemen, in my opinion this is a rather important matter, and I think it should be pretty well considered before it is adopted. We have had a great many suggestions here showing that the members of our Association are not of one mind. I would like to see this subject given further consideration.

MR. C. E. GOSLINE: Mr. President, I think we are on the wrong track on this seasoning proposition. Previous to this paragraph there should be stated some remarks as to the period of cutting and then reckon your seasoning months by the cutting. It is apparent there is some disagreement as to the number of months that each specie should be seasoned, and, therefore, I move you that this paragraph be cut out.

MR. O. C. STEINMAYER: I second that motion.

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MR E. A. STERLING: Mr. President, the Committee has had a little informal discussion here, and it feels that a clause should be added, to the effect that the periods mentioned refer to seasoning months, that is the months in which seasoning would occur; summer months, in other words.

MR. H. M. ROLLINS: Mr. President, that term "seasoning months" is not clear. I would like you all to recall what we saw on the screen this afternoon, slides showing ties that were placed in yards for seasoning in June, showing that those ties were decayed in November. Those were southern yellow pine. Now, if in the five months those ties are decayed, that is proof positive that 6 months would be too long. I do not think that that clause ought to go in as it is written in the recommendation.

MR. A. R. JOYCE: Would 3 to 6 months be satisfactory?

MR. H. M. ROLLINS: I would like to see it not more than four months.

MR. J. H. WATERMAN: A man in the north might want more.

MR. GEO. E. REX: I would just like to say to Mr. Rollins, that as you all know there are a great many kinds of yellow pine, and there is no reason in the world why longleaf yellow pine could not stand 8 months, while loblolly pine will stand 6 months all right if cut in certain months of the year. It might be beyond the question to put this limit on, but I think we do not expect to make a limit for a man to follow in a particular kind of a tie. If he has a tie that decays in six months, we do not expect him to use this long limit for that particular kind of tie, whereas he could leave the longleaf ties that long. This is to cover all kinds of ties. I think it is well taken. Personally, I would not object to seeing the minimum reduced to ninety days under proper conditions, but the specification there as written covers all the different kinds of ties, both the longleaf and the loblolly.

MR. O. C. STEINMAYER: Mr. President, I have seen some loblolly ties treated that were seasoned but 60 days. It is rather impractical to specify the number of months any species of timber should be seasoned. Mr. Eriscon made a recommendation about the moisture content. I think that is a very good one. I do not think it is possible to specify the number of months that you ought to season any timber under the varying conditions existing throughout the country. We have so many unknown quantities.

THE PRESIDENT: Gentlemen, if there are no further remarks, I will put the question, with the amendment that the Committee has already accepted. All those in favor of adopting this part of the report as just read and amended by the Committee will please signify

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it by saying "aye"; contrary, "no." I will have to ask you to stand up, and those of you who are interested in seasoning ties and have opinions on this I would like to have you vote.

MR. WM. A. FISHER: Can we have it read again, please?

THE PRESIDENT: Yes.

MR. A. R. JOYCE:

*Oak ties should be given a minimum of 8 months' seasoning, and should preferably be seasoned 12 months; yellow pine, if seasoned in the South, 3 to 6 months; hemlock, tamarack and jack pine, 12 months; gum, beech, birch and hard maple, 4 to 6 months.*

The reference above is to the seasoning months of the year.

MR. M. K. TRUMBULL: I think it is just about as essential that 3 to 6 months be used for gum as for pine. What is your opinion, Mr. Rex?

MR. GEO. E. REX: Well, I do not know. I would not like to undertake to treat any gum ties in three months.

MR. M. K. TRUMBULL: Short of three months?

MR. GEO. E. REX: I would not like to undertake to treat them if they only had 3 months' seasoning.

MR. M. K. TRUMBULL: I have seen gum ties go just as quickly as pine ties, at times.

MR. GEO. E. REX: That is true, but you also must remember if you get good treatment you have to have the water out of them and the water does not come out of gum ties as it does out of pine ties. I personally would not like to treat gum ties in 3 months.

THE PRESIDENT: All those in favor of the motion as just read by Mr. Joyce will please stand up. (17 stood up.) All those opposed will please rise. (6 stood up.) The motion is carried. That part of the report is adopted.

MR. A. R. JOYCE: Near the middle of page 423:

*All efficient plants should be equipped to steam material which occasion requires.*

I move the adoption of this paragraph as read.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Any objections? If not, this is considered adopted.

MR. A. R. JOYCE: At the top of page 424:

*In steaming the pressure should at no time exceed 20 lbs. per square inch, nor the oil temperature in boiling exceed 200° F. with possible exceptions in the case of some Pacific Coast timbers which may require higher temperatures.*

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I move the adoption of this paragraph as read.

MR. E. A. STERLING: I second the motion.

THE PRESIDENT: Any remarks?

MR. WM. A. FISHER: It seems to me that the limit of pressure allowed is hardly high enough to cover all timber that it may be desired to treat. There are undoubtedly some classes of timber that it is necessary to steam higher than 20 lbs. in order to get the desired impregnation. I feel that this limit as allowed is possibly 10 and may be 15 lbs. lower than might well be allowed for some timber that can stand that much steam pressure.

MR. H. M. ROLLINS: Mr. President, I would like very much for the Committee to add in the exceptions, longleaf pine along with Pacific Coast timber.

THE PRESIDENT: All those in favor of the motion to adopt this paragraph as read will please signify it by saying "aye"; all those opposed, "no." That is not a very strong vote, gentlemen.

MR. O. C. STEINMAYER: Do we understand the Committee has looked favorably to the recommendation made by Mr. Rollins?

THE PRESIDENT: The Committee does not see fit at this time to accept it.

MR. H. M. ROLLINS: I should like to add, if I am in order, that the Lighthouse Service specify merchantable longleaf pine, and they also specify an injection of 20 lbs. of oil to the cubic foot of timber. Now, I do not believe that it is possible to accomplish what their specifications call for with a maximum temperature that you would get with 20 lbs. steam pressure, and in view of the fact that the different United States Engineers' offices distributed along the Gulf Coast and the United States Lighthouse Service demand that class of material and that amount of oil injected, I think it well to go rather slow in limiting the maximum temperature that may be used in treating timber which we all know in years gone by has been subject to those high temperatures. It does not apparently result in any great injury to the timber, and it certainly does allow the injection of the required amount of oil.

THE PRESIDENT: Gentlemen, I am quite sure that there are more than two or three men in the room who have steamed timber and treated timber, and have some pretty good ideas on this question, at least ideas sufficiently definite to vote on the question. I am not going to accept the vote as taken, with yea and nay, but I am going to ask a vote on this question again and ask you to stand up. All those in favor of this motion as read will please rise to their feet.

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MR. M. K. TRUMBULL: Mr. President, I would like to explain my vote. It is the understanding that 20 lbs. steam-pressure is gauge-pressure, that is pressure below the atmosphere.

MR. A. R. JOYCE: Steam-gauge pressure.

THE PRESIDENT: All those opposed will please rise to their feet. The motion is carried.

MR. A. R. JOYCE: At the bottom of page 424, the Committee recommends the following:

> *The use of the full-cell process for piles and other marine timbers where subject to attack of the teredo and other marine borers, and that in such situations an injection of at least 20 lbs. per cubic foot, or treatment to practical refusal, should be given; while in marine and land situations where decay is the principal source of failure, treatments may range down from 20 to 10 lbs. per cubic foot by the same process, the injection in all cases to be sufficient to penetrate all the sapwood.*
>
> *The full-cell treatment in permanent structures not subject to mechanical wear when conditions of moisture, climate or humidity are favorable to wood-destroying fungi, and particularly where the cost of renewals or replacement would be high.*

I move the adoption of these as read.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: Are there any objections? If not this part of the report is considered adopted.

MR. A. R. JOYCE: At the bottom of page 425:

> *In all outside situations it is recommended that a maximum injection of creosote, or sufficient to insure the penetration of all treatable wood, be required and that not less than an average of 5 lbs. of creosote per cubic foot be left in the treatable portions of the wood; while it is urged as a definitely specified requirement, that at least all of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated, and the depth or extent of the penetration be equal to that of the full-cell treatment.*

I move the adoption of this paragraph as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Are there any objections to this paragraph?

MR. W. F. GOLTRA: I would like to inquire if the recommendation that a "maximum injection of creosote or a sufficient quantity to insure the penetration of all the treatable wood" is not identically the same thing as treating to "refusal"? If we do not treat to refusal, how

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can we attain the object of this recommendation? The same question applies to Article IV, where we say:

> In treating with creosote oil, it is recommended that a maximum injection of creosote sufficient to insure the penetration of all treatable wood be required.

Then we go on and say when

> Treating with zinc chloride, it is essential that all timber be treated to refusal.

I am unable to see the difference between the two. I do not understand how it is possible to inject a maximum amount of creosote oil or zinc chloride into the timber unless it is treated to refusal. And, conversely, if the timber is not treated to refusal, no matter what kind of preservative is used, we are not giving it a maximum injection and the result is only a partial treatment.

THE PRESIDENT: All those in favor of this paragraph being accepted will please signify it by saying "aye"; opposed, "nc." The motion is carried.

MR. A. R. JOYCE: On page 426:

> *Where zinc chloride alone is used it be by the standard process known as Burnettizing, and that a full impregnation which will insure the retention of a minimum of ½ lb. of dry salt per cubic foot of timber be given.*
>
> *We suggest zinc chloride treatment in arid and semi-arid regions, particularly for cross-ties and other material with mechanical life limited to the expectation of life from decay and checking; also for woods resistant to creosote. It should not be used where mechanical wear is eliminated, nor in situations where the treated timber is in permanent or intermittent contact with either stagnant or flowing water. Consideration should also be given to its use on overhead trestles and similar structures.*
>
> *Under usual conditions three months' seasoning after treatment is advisable.*

I move the adoption of these paragraphs as read.

MR. GEO. E. REX: I second the motion.

MR. E. H. BOWSER: I move we omit the paragraph, "Also for woods resistant to creosote."

THE PRESIDENT: Did you make that as a motion?

MR. E. H. BOWSER: Yes.

MR. WM. A. FISHER: I second the motion.

MR. GEO. M. HUNT: Mr. Chairman, I think it can be definitely proven that zinc chloride will go into certain woods easier than creosote. I have not the data here to show, but it can be shown that zinc chloride will go into some woods much better than creosote.

MR. E. H. BOWSER: I would like to hear Mr. Rex on that.

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THE PRESIDENT: Has Mr. Rex anything to say? Are you ready for the——

MR. A. R. JOYCE: Mr. President, there are some very interesting facts available in connection with certain species of woods, which apparently are not more resistant to creosote than to an aqueous solution, but I think the Committee is willing to accept Mr. Bowser's amendment and strike from the paragraph "Also for woods resistant to creosote."

MR. O. C. STEINMAYER: Mr. President, I should like the Committee to consider the substitution of "treatment" for the word "it," in the second line. The clause would then read:

> We recommend where zinc chloride alone is used treatment be by the standard process known as Burnettizing.

MR. A. R. JOYCE: We accept that, Mr. Steinmayer.

THE PRESIDENT: Are there any further remarks?

MR. M. K. TRUMBULL: Mr. President, I would like to raise just one question, and that is of phraseology. Would it not possibly be a little better to say "it is recommended" than as printed, "we recommend"? The same wording appears several places before this.

MR. A. R. JOYCE: That is satisfactory.

THE PRESIDENT: That is a very good point for the Editor. Gentlemen, the Committee has accepted the corrections suggested by Mr. Bowser and by Mr. Steinmayer, as well as that by Mr. Trumbull. All those in favor of adopting this part of the report will please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: The final paragraph on page 426:

> *Creosote-zinc in mixture is fundamentally effective because composed of the two most widely accepted preservatives. In situations where the mixture is preferable to a single preservative, it should be used according to the judgment of the consumer as to its greater economy and efficiency under local conditions.*

I move the adoption of this paragraph as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Any remarks? If not, this motion is carried.

MR. A. R. JOYCE: Mr. President, I move you that the balance of this report be accepted as information by the Association.

MR. LOWRY SMITH: I second the motion.

THE PRESIDENT: All those in favor of accepting the remainder of this report be accepted as information by the Association.

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MR. LOWRY SMITH: I second the motion.

THE PRESIDENT: All those in favor of accepting the remainder of this report as information please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. J. H. WATERMAN: Mr. President, I move you we compliment the Committee on the work it has done.

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: I just want to hear Mr. Shanesey.

MR. M. T. SHANESEY: Mr. President, in looking over the report presented by Committee on Specification for the Purchase and Preservation of Treatable Timber, it will be noticed that a great deal of emphasis is placed on the necessity for having good drainage in the seasoning yard, which it is recommended should not be in a low or humid situation. It is also generally understood that only perfectly sound timber should be treated.

These views are no doubt most heartily approved. I am of the opinion that it would be advisable to make this policy more expansive and apply it at least to some extent in the tie and timber producing fields and at points where material of this kind is loaded for shipment.

After observing the convincing pictures displayed here today by Mr. Waterman and Mr. Rex, in which the inadvisability of accepting anything but perfectly sound timber has been clearly demonstrated, it certainly appears absolutely necessary that a campaign of education should be introduced among producers and the greatest publicity given by purchasers and those interested in the treatment, as to best methods of piling and care which should be given ties and timber so as to lessen the liability of material becoming defective while it is being held for shipment.

If proper drainage and certain methods of piling are good things at the seasoning yards, it is very evident that there is room for improvement at the loading points where ties are accumulated for shipment.

From observations taken I feel that not only the members who are interested in the purchase and inspection, but also those employed in connection with the treatment, are vitally interested in securing some improvement in the way of proper care being given ties and timber from the time manufactured until placed on cars for shipment to the treating plants.

There are times when, through car shortage, or inability to get labor, that ties are held at the loading points for several months, and, if not properly piled, soon become defective. The manner of piling

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should be standardized so that, if for any reason the producers are forced to hold ties for an indefinite length of time, they would not deteriorate, thus eliminating or at least minimizing the loss which is being sustained not only by purchasers but also producers and which ultimately would be immensely profitable to all concerned.

It being generally understood that there is no justification for treating anything but sound timber, it would seem that some method should be applied to lessen the liability of ties in an incipient stage of decay being accepted.

All of the purchasers employ inspectors to see not only both ends but all sides of each and every tie before rejecting or accepting them.

Under existing conditions some of the producers make a practice of standing the ties on ends in yards which have no drainage whatever, where after rains the ties are nearly, if not entirely, surrounded by mud and water.

When these yards dry out to an extent where it is possible for an inspector to get to the ties, it is found that their ends which have been in contact with the soil, are covered with mud and sometimes with ice and snow, so that the condition of ties cannot be determined on account of moisture conditions.

From examination which has been made of ties which have stood on ends and were later shipped to treating plants for seasoning, it was found that when the sun would melt the ice and snow, or rain would wash the mud from the ends, decay would be disclosed. Not being sound, such ties would be relegated to the cull pile and either sold for construction ties at considerable loss or destroyed as worthless on account of being unfit for any use.

The inspectors concerned are not so much to blame in such cases as their superiors who permit them to inspect under conditions where it is impossible for them to observe or discern the defects which are entirely concealed by the mud adhering to the ties from contact with the soil.

Some of the railroads, realizing the possibility of serious loss, are so strongly opposed to accepting ties stacked on ends that they are refusing to accept them, while others have served notice on contractors and producers that after certain dates ties piled in this way will not be accepted.

The fact having been most firmly established that, if ties are not given proper care at loading points, they will soon decay and as there is no better way to protect the future than by applying experience previously gained and as just about all purchasers and inspectors are united in the belief that it is a very bad practice to stand ties on ends, I

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therefore move for inclusion in the MANUAL OF RECOMMENDED PRACTICES, the following:

*Ties or timber which have been allowed to stand on their ends should not be accepted.*

MR. F. J. ANGIER: Mr. President, I would like to second that motion and would like to have our Chief Inspector, Mr. Rowland, make some remarks on it.

MR. J. R. ROWLAND: Being out of the hall for a few minutes, I did not hear the first of Mr. Shanesey's remarks, but heard all he had to say about making inspection of cross-ties piled on end, and I agree with him on every remark he made. We have been having considerable trouble in making inspections of cross-ties standing on end in Kentucky, Ohio and Tennessee territory. We find it is impossible to secure real good ties when they are piled in this manner, on account of the fact that a great many are piled in mud holes or pools of water which makes it impossible for an inspector to see the end of the ties that rests on the ground as this end is usually covered with mud or dirt during warm weather and is covered with ice during the winter months. On this account we occasionally accept bad ties as our inspectors' sight cannot penetrate to the ends of such ties through this mud, dirt or ice as the case might be, and where conditions in tie yards where this method of piling is practiced are very bad the chances are that a great many inferior ties will get by the inspector no matter how careful he is.

It has only been a few days since I was out on our line looking up a carload of ties when I accidently ran across another load of ties that had been unloaded at the point I visited and in looking over these ties I readily discovered they had been piled on end and that the inspection had been made while they were piled in this manner. In looking over these ties, of which there were 410, I found nine with badly rotten ends with mud and dirt still clinging to them which had been accepted as Grade 1, but should have been rejected, and this inspection was made by one of our best and most careful inspectors who I am sure would have rejected these ties could he have seen the ends. This I think proves conclusively that proper inspection of ties standing on end cannot be made, and like Mr. Shanesey, I believe the practice of piling ties in this manner should be broken up everywhere, not only in the territory mentioned, but every place where we find ties piled in this manner. We have also had a great deal of trouble in making inspections of ties during the winter months when piled on end as we find them frozen together and have to be pried apart with bars. I have been on piles of ties standing on end that were so solidly frozen together that it required two men with steel bars to pry them apart. This is another drawback in making inspection of ties piled on end.

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I think all cross-ties in foreign territory should be piled in ricks or square piles, and on a road's own right-of-way they should be piled in accordance with that particular road's specifications. This gives inspectors a chance to see both ends, sides and faces, and enables them to make a thorough inspection, which cannot be done with ties piled on end. I think the method of piling cross-ties on end should be discouraged not only by contractors and buyers, but also by inspectors, and in fact, by every person interested in the cross-tie business. I believe also that contractors and buyers should be given notice that after a reasonable time no ties would be inspected that are piled on end, and after the expiration of such time the different railroads throughout the country should discontinue inspecting ties found piled on end.

THE PRESIDENT: Are there any further remarks on this motion?

MR. E. H. BOWSER: We do not attempt to inspect ties, either on end or in ricks without re-handling. When it comes to inspection it does not make any difference which way they are piled.

MR. O. C. STEINMAYER: In the South in a great many places, where the tie production is very heavy, the only way tie contractors can get their ties close to the station to handle them from side tracks is by putting them on end. That is the explanation they have given me. They do not believe in the practice themselves, but they are short of room and by standing them on end they can get a great number of ties in a minimum area. I believe it would be a good thing for this Committee to make a recommendation to the effect that all ties be moved to a seasoning yard as soon after cutting as possible, so that the ties can be seasoned under proper supervision.

MR. F. J. ANGIER: Mr. President, I would like to say a word on that. We have experienced a good deal of difficulty in inspecting ties piled in this manner. We find that in some places ties have been standing on end as long as six years before they can be taken up. This is brought about from the fact that they start to pile these ties on end and keep on adding to the pile round and round until they have a pile perhaps of several thousand. We all know how the car situation is. We have cars sent there and can only load up a few of those ties. The outer ties are loaded. Before our inspector can get around and take up more ties, additional ties are stood on end around this core, and the result is that the inside is left there for years and decay sets in and surely the decayed ties in the center do not do the outside ties any good. I think that it is a bad practice and should be broken up.

THE PRESIDENT: If there are any other remarks that you feel will throw light on the subject I will be glad to give you the time if you will make your remarks brief. If not, I will put the motion.

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MR. E. H. BOWSER: I do not agree with them as to the time. There should be a limit of time about standing ties on end. Sometimes you bring them out of the river, place them on end and keep right on loading them. It means only two or three days in this position, and when they are put on good ground it does not hurt them at all.

MR. F. J. ANGIER: You cannot get your inspectors there always on the date you get your cars.

MR. M. T. SHANESEY: In most cases ties are stood on end in order to facilitate the work of unloading, on the part of the producers. They drive the wagon up to the loading point, where the ties are accumulated for shipment, and pull one end off and up-end the tie, which, of course, lessens the expense of loading. As Mr. Angier just said, cases have been discovered where in a large accumulation of ties a great many have been in the yard for several years. Now, it would appear to be immensely profitable to all concerned if something was done in the way of standardizing the piling of the ties.

For instance, the inspector goes out to the loading point to take them up, and, of course, he knows as a matter of common knowledge that ties that have been in contact with the soil soon become defective. Now, he looks over a lot of ties, and perhaps to outward appearances there are no defects discernible, but the very fact that they have been handled improperly would justify the belief that he ought to make a closer examination. He takes a saw and cuts off the ends of some of the ties that have been in contact with the soil, which reveals an incipient stage of decay. He rejects several thousand ties which if properly cared for would have been available for use on the different railroads. It is a crime for the railroads to lose them, and it is a crime for the producers to lose them, owing to improper handling. By discouraging the practice of standing ties on end it means that more ties will be available. There will not be so many relegated to the cull pile.

MR. F. S. POOLER: Mr. President, I want to say a word in connection with this. We purchase hundreds of thousands of ties every year along our right-of-way. They are delivered by small dealers mostly. A great many of them are white oak. I would not think of accepting ties piled in the manner which you mention. We do not even accept them piled in ricks, and the way to regulate that is by putting it in your contract. You can regulate it all right if you do that, and then if the inspector goes there and finds the ties are not properly piled, he can simply refuse to inspect them. That is simple. We have no trouble at all.

MR. J. H. WATERMAN: Mr. President, this motion is to encourage proper piling. You can make a contract, no matter what we do here. Mr. Pooler can go home and make a contract right opposite

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to this. We have not any strings on him, but as an Association we want to stand for high ideals.

THE PRESIDENT: Any further remarks? If you are ready for the question, all those in favor of the question please signify it by saying "aye"; all those opposed, "no." The motion is carried. I will be glad to recognize Mr. Waterman now.

MR. J. H. WATERMAN: I move you that we compliment the Committee on its efficient work, and hope that the next President will recognize it and give it an opportunity to do some more work.,

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: All those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

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## REPORT OF COMMITTEE ON SPECIFICATIONS FOR THE PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

*To the Members of the American Wood-Preservers' Association:*

The portions of the report printed in italic type are recommended for inclusion in the MANUAL.

### A.—Fundamental Principles.

**1. Only perfectly sound timber should be treated.**

Consideration of the effect of decay on the strength of wood is essential. Decay even when not very noticeable, may greatly reduce the strength value, and hence, with species which decay rapidly, but short service may result in a decided weakening.

**2. In order to obtain the best results properly seasoned material should be used.**

Preparing timber for treatment embodies mainly the various steps in the seasoning process, and is a very important factor in determining the ultimate value of the treated material. Owing to the wide diversity of conditions and the individual characteristics of the different woods, it is difficult to specify definitely under this heading.

*Whenever conditions will permit, thoroughly air season all structural timber, track ties, piles and other materials before treatment. So far as practical arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity.*

Pile incoming material in its proper groups or classes, separating green from seasoned or partially seasoned material, and using successive portions of the yard for the storing of green timber.

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*The seasoning yard should be in the open where the prevailing winds will strike it freely; should not be in a low and humid situation of any kind if it can be avoided; should have good drainage; and should be kept free from weeds and grass and decaying wood material.*

*All outer bark should be removed before treatment, and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should over 10% or strips over 1 in. wide and 6 ins. long be left.*

*When there is not sufficient time for proper air seasoning, or, in the case of piling and large dimension timbers which will not air season successfully throughout without deterioration, artificial seasoning by steaming or boiling before treatment must be resorted to.*

**3. A good preservative is essential to long life.**

COAL-TAR CREOSOTE.

From the standpoint of permanence and protection of wood against decay and marine borers, coal-tar creosote is the best available preservative for general purposes. It possesses the necessary theoretical requirements, and has stood all practical tests through many years' use under varying conditions of service and in many different kinds of material.

ZINC CHLORIDE.

Zinc chloride is of great importance as a preservative, and is the only mineral salt extensively used for wood preservation. It deserves full consideration in regions of low precipitation, in dry situations, and where low first cost is essential. It came into use in this country even before creosote, and has in most cases given service which fully justifies its application. While the life of zinc treated material is usually less than that of creosoted, the expense is also less, and the relation of cost to service is an important consideration.

FACTORS TO BE CONSIDERED IN COMPARING PRESERVATIVES:

(1). The toxicity of the preservative, namely, its ability to prevent decay.

(2). The ability of the preservative to penetrate the wood.

(3). The permanency of the preservative in the wood.

(4). The effect of the preservative on the strength of the wood.

(5). The effect of the preservative on the corrosion of spikes and plates, and the operation of block signals.

(6). The cost of the preservative.

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(7). The uniformity in composition of the preservative and ease of securing it.

(8). The combustibility of the preservative.

(9). The ease of handling the preservative and wood treated with it.

(10). The ease with which the penetration of the preservative can be determined.

Preservative treatments with creosote and zinc chloride when properly made, affect the strength of wood so slightly that any difference in crushing value is of little or no practical importance.

**4. Proper injection as to quantity and penetration is essential.**

*In treating with creosote, it is recommended that a maximum injection of creosote sufficient to insure the penetration of all treatable wood be required. All of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated. This applies equally to full-cell and empty-cell treatments.*

*In treating with zinc chloride it is essential that all timber be treated to refusal.*

The treatment in the same cylinder charge of wood having great dissimilarity of permeability is not expected to give the best results until the treatment is carried to absolute refusal.

The time of treatment required to obtain absolute refusal varies in different species and with different seasoning, so much as to make serious delay in the case of the species of wood which have first reached totality waiting in the cylinder for the more refractory to obtain it.

**5. Proper subsequent handling of timber is essential.**

*Wherever possible, all timber should be framed before treatment, and in lieu of this unimpregnated wood exposed by framing after treatment should be thoroughly painted with hot creosote.*

*To secure the best results it is necessary to protect treated material from mechanical abrasion both in handling and under service conditions.*

**6. Accurate records as to the life and cost of treated material are essential.**

It has been the general experience that most satisfactory results are secured by maintenance of a limited number of intensive records of representative sections.

Two methods are in use for determining the annual costs of both treated and untreated material. One of these is the well-known amortization method, which involves the principle of compound interest; the other is a simpler method in which simple interest is used.

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## B.—Selection of Treatable Timber.

### 1. Structural Timber.

The fundamental requirements of structural timbers for treatment are strength and capacity for treatment to an extent which will insure protection against decay on all exposed surfaces. *A penetration of ½ in. on the heart faces may be recommended as a safe minimum on structures above ground,* although with a few resistant woods as good a treatment as can be expected will show less than ½ in. penetration in the heart.

The strength requirement is determined by the species, and is further dependent upon the soundness, density of the wood, frequency, size and location of the knots, the extent, character and location of shakes and checks, and the character of the grain. Treatability in most woods is determined by the proportion and relation of heartwood and sapwood, with exceptions in the case of heartwood which takes treatment. *Where strength is required, not only the defects which might reduce the strength but also the quality as determined by density should be specified; but where strength is not an essential only the soundness of the timber and the sapwood requirements as determining penetrability need be considered.*

Since sapwood of like density and moisture content to heartwood, is also of like strength, the relative proportion of sap and heart on the same species may be considered from this standpoint.

While the mechanical properties of ties as with structural timbers are dependent upon the density of the wood, it seems neither practicable nor advisable at this time to propose density restrictions for tie specifications.

*(a)* RESTRICTIONS ON KNOTS, SHAKES, CHECKS AND CROSS GRAIN.

Adopt the specifications which were adopted during 1915 by the Southern Pine Association. These specifications should apply to all structural timbers where strength is a prerequisite.

> RESTRICTIONS ON KNOTS IN BEAMS. Shall not have in Volume 1 sound knots greater in diameter than one-fourth the width of the face on which they appear—maximum knot 1½ inches. Shall not have in Volume 2 sound knots greater in diameter than one-half the width of the face on which they appear—maximum knot 3 inches.
>
> The aggregate diameter of all knots within the center half of the length of any face shall not exceed the width of that face.
>
> The diameter of a knot on the narrow or horizontal face of a beam is to be taken as its projection on a line perpendicular to the edge of the timber. On the wide or vertical face, the smallest dimension of a knot is to be taken as its diameter.
>
> RESTRICTIONS ON KNOTS IN COLUMNS. Shall not have sound knots greater in diameter than one-third the least width of the column—maximum knots 4 inches.

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RESTRICTIONS ON SHAKES AND CHECKS IN BEAMS. Round or ring shakes shall not occupy, at either end of a timber, more than one-fourth the width of green material, nor more than one-third the width of seasoned material.

Any combination of checks and shakes which would reduce the strength to a greater extent than the allowable round shakes will not be permitted. Shakes shall not show on the faces of either green or seasoned timber.

RESTRICTIONS ON CROSS GRAIN IN BEAMS. Shall not have diagonal grain with slope greater than one in twenty in Volume 1.

*(b)* RESTRICTIONS ON DENSITY AND RATE OF GROWTH OF SOUTHERN YELLOW PINE.

Adopt the specifications which were adopted during 1915 by the Southern Pine Association and which have been recommended by the Committee on Specifications for Timber of the American Society of Testing Materials, and used in the building code of the National Board of Fire Underwriters. These specifications apply to all southern yellow pine structural timbers where strength is prerequisite.

SOUTHERN YELLOW PINE. This term includes the species of yellow pine growing in the Southern States from Virginia to Texas, that is, the pines hitherto known as longleaf pine *(Pinus palustris)*, shortleaf pine *(Pinus echinata)*, loblolly pine *(Pinus taeda)*, Cuban pine *(Pinus heterophylla)*, and pond pine *(Pinus serotina)*.

Under this heading two classse of timber are designated: (A) dense Southern yellow pine and (B) sound Southern yellow pine. It is understood that these two terms are descriptive of quality rather than of botanical species.

Dense Southern yellow pine shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth, and fifth inches of a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

In cases where timbers do not contain the pith, and it is impossible to locate it with any degree of accuracy, the same inspection shall be made over 3 ins. on an approximate radial line beginning at the edge nearest the pith in timbers over 3 ins. in thickness and on the second inch (on the piece) nearest to the pith in timbers 3 ins. or less in thickness.

In dimension material containing the pith but not a 5-in. radial line, which is less than 2x8 ins. in section or less than 8 ins. in width, that does not show over 16 sq. ins. on the cross-section, the inspection shall apply to the second inch from the pith. In larger material that does not show a 5-in. radial line the inspection shall apply to the three inches farthest from the pith.

The radial line chosen shall be representative. In case of disagreement between purchaser and seller the average summer wood and number of rings shall be the average of the two radial lines chosen.

Sound Southern yellow pine shall include pieces of Southern pine without any ring or summer wood requirement.

It is not possible at the present time to recommend similar density and rate of growth specifications for other species.

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*(c)* SAPWOOD RESTRICTIONS.

Since, for a given species, sapwood of equal moisture content and density, (see explanation in Southern Pine Association's Grading Rules) is as strong as heartwood, sapwood restrictions need only be considered in relation to the efficiency of treatment. With red oaks, hemlocks, and spruces, for reasons brought out under the discussion on ties, no consideration need be given to sapwood restrictions. With the pines and Douglas fir, however, the amount and distribution of sapwood is of much importance. The following classes listed in the order of their suitability for treatment cover restrictions of this nature:

(1). Timbers showing no heart on any face.
(2). Timbers showing no sap on any face.
(3). Heart face timbers with not less than 80% heartwood.
(4). Heart face timbers with not over 20% heartwood.
(5). Other timbers not falling in any of the foregoing classes.

*(d)* OTHER RESTRICTIONS.

For other restrictions not covered in the foregoing, it is recommended that the specifications of the American Railway Engineering Association, as given on pages 231-234, inclusive, of the 1915 edition of its Manual and reprinted below, be adopted:

STANDARD SPECIFICATIONS FOR SOUTHERN YELLOW PINE BRIDGE AND TRESTLE TIMBER.

(To be applied to single sticks and not to composite members.)

GENERAL REQUIREMENTS.

1. Except as noted, all timber shall be sound, sawed to standard size, full length, square cornered and straight; close grained and free from defects such as injurious ring shakes and cross grain, unsound or loose knots, knots in groups, decay, or other defects that will materially impair its strength.

STANDARD SIZES.

2. "Rough timbers sawed to standard size" means that they shall not be over ¼ in. scant from the actual size specified. For instance, a 12x12 in. timber shall measure not less than 11¾x11¾ inches.

STANDARD DRESSING.

3. "Standard dressing" means that not more than ¼ in. shall be allowed for dressing each surface. For instance, a 12x12 in. timber, after being dressed on four sides, shall measure not less than 11½x11½ inches.

STANDARD HEART GRADE, LONGLEAF YELLOW PINE.

STRINGERS.

4. Stringers shall show not less than 85% heart on the girth anywhere in the length of the piece; provided, however, that if the maximum amount of sap is shown on either narrow face of the

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stringer, the average depth of sap shall not exceed ½ inch. Knots greater than 1½ ins. in diameter will not be permitted at any section within 4 ins. of the edge of the piece, but knots shall in no case exceed 4 ins. in their largest diameter.

CAPS AND SILLS.

5. Caps and Sills shall show not less than 85% heart on each of the four sides, measured across the sides anywhere in the length of the piece, and shall be free from knots over 2½ ins. in diameter.

POSTS.

6. Posts shall show not less than 75% heart on each of the four sides measured across the sides anywhere in the length of the piece, and shall be free from knots over 2½ ins. in diameter.

LONGITUDINAL STRUTS AND GIRTS.

7. Longitudinal Struts and Girts shall be square cornered and sound. One side shall show all heart; the other side shall show not less than 85% heart, measured across the side anywhere in the length of the piece, and shall be free from any large knots or other defects that will materially injure their strength.

LONGITUDINAL X BRACES, SASH AND SWAY BRACES.

8. Longitudinal X Braces, Sash Braces and Sway Braces shall be square cornered and sound; shall show not less than 80% heart on each of two sides, and shall be free from any large knots or other defects that will materially injure their strength.

TIES AND GUARD RAILS.

9. Ties and Guard Rails shall show one side all heart; the other side and two edges shall show not less than 75% heart, measured across the surface anywhere in the length of the piece; shall be free from any large knots or other defects that will materially injure their strength; and where surfaced the remaining rough surface shall show all heart.

## STANDARD GRADE, LONGLEAF AND SHORTLEAF YELLOW PINE.

STRINGERS.

10. Stringers shall be square cornered, with the exception of 1 in. wane on one corner or ½ in. wane on two corners. Knots shall not exceed in their largest diameter one-fourth of the width of the surface of the stick in which they occur, and shall in no case exceed 4 inches. Ring shakes shall not extend over one-eighth of the length of the piece.

CAPS AND SILLS.

Caps and Sills shall be square cornered, with the exception of 1 in. wane on one corner, or ½ in. wane on two corners. Knots shall not exceed in their longest diameter one-quarter the width of the surface of the stick in which they occur, and in no case shall exceed 4 inches. Ring shakes shall not extend over one-eighth of the length of the piece.

POSTS.

Posts shall be square cornered, with the exception of 1 in. wane on one corner, or ½ in. wane on two corners. Knots shall not exceed, in their longest diameter, one-fourth of the width of the surface of the stick in which they occur, and shall in no case exceed 4 inches. Ring shakes shall not extend over one-eighth of the length of the piece.

## STANDARD SPECIFICATIONS FOR DOUGLAS FIR AND WESTERN HEMLOCK BRIDGE AND TRESTLE TIMBERS.

(To be applied to single sticks and not to composite members.)

STANDARD HEART GRADE.

1. Standard Heart Grade shall include yellow and red Douglas fir and Western hemlock. White Douglas fir will not be accepted.

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GENERAL REQUIREMENTS.

1. All timber shall be live, sound, straight and close grained, cut square cornered, full length, not more than ¼ in. scant in any dimension for rough timber or ⅛ in. for dressed timber; free from large, loose or unsound knots, knots in groups, or other defects that will materially impair its strength for the purpose for which it is intended, and subject to inspection before loading.

STRINGERS.

3. Stringers shall show not less than 90% heart on each side and edge, measured across the surface anywhere in the length of of the piece. Stringers shall be out of wind and free from shakes, splits, or pitch pockets over ⅜ in. wide or 5 ins. long. Knots greater than 2 ins. in diameter will not be permitted within one-fourth of the depth of the stringer from any corner nor upon the edge of any piece. Knots shall in no case exceed 3 ins. in diameter.

CAPS, SILLS AND POSTS.

4. Caps, Sills and Posts shall show not less than 85% heart on each of the four sides, measured across the surface anywhere in the length of the piece; which shall be out of wind and free from shakes, splits, or pitch pockets over ⅛ in. wide or 5 ins. long. Knots shall not exceed one-fourth of the width of the surface of the piece in which they occur and shall in no case exceed 3 ins. in diameter.

LONGITUDINAL STRUTS OR GIRTS, X BRACES, SASH AND SWAY BRACES.

5. Longitudinal Struts or Girts, X Braces, Sash and Sway Braces shall show one side all heart. The other side and two edges shall show not less than 85% heart, measured across the surface anywhere in the length of the piece.

TIES AND GUARD TIMBERS.

6. Ties and Guard Timbers shall show one side and one edge all heart. The other side and edge shall show not less than 85% heart, measured across the surface anywhere in the length of the piece.

HOWE TRUSS CHORDS.

7. Timbers for Howe Truss Chords shall show not less than 90% heart on each side and edge, measured anywhere in the length of the piece. They shall be out of wind and free from shakes, splits or pitch pockets over ⅛ in. wide or 3 ins. long. Knots shall not be over 1⅛ ins. in diameter nor be closer together on each surface than one in any 4 lin. ft.; but if knots are 1 in. or less in diameter, one knot in any 3 lin. ft. will be allowed.

## STANDARD GRADE.

8. Standard Grade shall include yellow, red and white Douglas fir and Western hemlock.

GENERAL REQUIREMENTS.

9. All timbers shall be sound and cut square cornered, except that timber 10x10 ins. in size may have a 2-in. wane on one corner or its equivalent on two or more corners. Other sizes may have proportionate defects. Must be free from defects which will impair its utility for temporary work. Knots shall not exceed one-fourth the width of the surface of the piece in which they occur. Timber must be subject to inspection before loading.

STRINGERS, CAPS, SILLS AND POSTS.

10. Stringers, Caps, Sills, and Posts shall be out of wind, free from shakes or splits extending over more than one-eighth of the length of the piece, or knots more than 4 ins. in diameter. Knots greater than 3 ins. in diameter will not be permitted on the edge of any stringer.

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**2. Track Ties.**

The mechanical properties of timber in relation to the requirements of service conditions and its permeability by the preservative must be considered in selecting species.

The sorting of timbers before treatment is progress in the right direction. It is preferable to treat in each cylinder charge one species of timber.

**3. Piles.**

The selection and purchase of piles for treatment should take into consideration their ultimate use, whether in salt or fresh water, for land foundation or marine work, and particularly whether subject to marine borers. The sapwood requirements, especially when the heartwood is resistant to treatment, should be based directly on service considerations. The following sapwood restrictions are based on classification of the character of service for which the pile is to be used:

*(1). Piles for use in salt water where ravages of marine borers are extremely severe: Specify not less than 2½ ins. of sapwood, nor more than 5 inches.*

*(2). Piles for use in salt water where ravages of marine borers are less severe than in Group 1: Specify not less than 1 in. sapwood, nor more than 3 inches.*

*(3). Piles for use in fresh water or foundation work on land: No sapwood restrictions are necessary.*

For the present the specifications of the American Railway Engineering Association (1915 Manual, pages 235-236) reprinted below, may be followed as to dimensions and defects of piles:

RAILROAD HEART GRADE.

(1). This grade includes white, burr, and post oak; longleaf pine, Douglas fir, tamarack, Eastern white and red cedar, chestnut, Western cedar, redwood and cypress.

(2). Piles shall be cut from sound trees; shall be close grained and solid, free from defects, such as injurious ring shakes, large and unsound or loose knots, decay or other defects, which may materially impair their strength or durability. In Eastern red or white cedar a small amount of heart rot at the butt, which does not materially injure the strength of the pile, will be allowed.

(3). Piles must be butt cut above the ground swell and have a uniform taper from butt to tip. Short bends will not be allowed. A line drawn from the center of the butt to the center of the tip shall lie within the body of the pile.

(4). Unless otherwise allowed, piles must be cut when sap is down. Piles must be peeled soon after cutting. All knots shall be trimmed close to the body of the pile.

(5). The minimum diameter at the tips of round piles shall be 9 ins. for lengths not exceeding 30 ft.; 8 ins. for lengths over 30 ft. but not exceed 50 ft., and 7 ins. for lengths over 50 feet. The minimum diameter at one-quarter of the length from the butt shall be 12 ins. and the maximum diameter at the butt 20 inches.

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(6). The minimum width of any side of the tip of a square pile shall be 9 ins. for lengths not exceeding 30 ft.; 8 ins. for lengths over 30 ft. but not exceeding 50 ft., and 7 ins. for lengths over 50 feet. The minimum width of any side at one-quarter of the length from the butt shall be 12 inches.

(7). Square piles shall show at least 80% heart on each side at any cross-section of the stick, and all round piles shall show at least 10½ inches diameter of heart at the butt.

RAILROAD FALSEWORK GRADE.

(8). This grade includes red and all other oaks not included in Railroad Heart Grade, sycamore, sweet, black and tupelo gum, maple, elm, hickory, Norway pine or any sound timber that will stand driving.

(9). The requirements for size of tip and butt taper and lateral curvature are the same as for Railroad Heart Grade.

(10). Unless otherwise specified piles need not be peeled.

(11). No limits are specified as to the diameter or proportion of heart.

(12). Piles which meet the requirements of Railroad Heart Grade except the proportion of heart specified will be classed at Railroad Falsework Grade.

## C.—Preparation of Timber for Treatment.

### 1. Air Seasoning.

Adjust the methods of piling ties and lumber for seasoning to the local climate conditions, so as to obtain maximum rapidity in seasoning without undue checking or warping. *Support all piles on treated sill ties, and in all cases at least 6 ins. of air space should be allowed underneath. To allow proper air circulation, the alleys between the piles should extend in continuous lines across the seasoning yard and should be not less than 3 ft. in the working spaces and 1 ft. in other directions.*

*In a moist climate and under humid conditions, season all material in open piles, which will provide free circulation of air and exposure to the sun. By open piles is meant the common 1x7, 1x8 or 7x2 piling system, or other arrangement which gives a minimum contact and the maximum of open spaces between the ties. Insist that the stringers be placed as near the end of the ties as possible, then in case of any defects from contact they will not fall upon the rail bearing. In arid climates with low humidity, season in close piles to prevent checking and warping.*

Practically all woods can be air seasoned except in low humid locations. Gum is an exception, unless air seasoned under favorable conditions. *Both gum and beech should be seasoned only in wide open piles and watched very carefully for rot.* Bluing of sap pine during seasoning is not necessarily an indication of decay; it should be watched very closely, however, for the brown blotches, which are indications.

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*Ties and timbers which have a tendency to check should be protected with "S" irons, or other devices.* These should be applied in the seasoning yard to all sticks showing serious initial checks in order to prevent further checking during or after treatment. Red oak and beech should be watched closely in this regard. *All ties should be bored and adzed before treatment,* this insures a uniform bearing surface and maximum penetration at the rail seat. *All timbers should be framed before treatment;* this prevents any exposure of untreated surface where decay would first start.

*Oak ties should be given a minimum of eight months seasoning, and should preferably be seasoned 12 months; yellow pine if seasoned in the south, 4 to 6 months; hemlock, tamarack and jack pine 12 months; gum, beech, birch, and hard maple from 4 to 6 months.* Winter cut beech is preferable to summer cut; summer cut checks more readily and the sapwood turns dark in seasoning. Over seasoning may prove detrimental with some species.

A determination of whether wood is sufficiently air seasoned for efficient treatment may be based on moisture extraction from borings which should show an average of not over 30% moisture in relation to the oven dry weight of the wood; or, if the above moisture determinations can not be made, season to a constant weight. Consideration may be given to a new Troemroid scalometer device for determining the moisture content of wood. In some cases it is advisable to make local experiments to determine the weight at which timber treats best. (See Bulletin 161, American Railway Engineering Association on "Air Seasoning of Timber.")

*All efficient plants should be equipped to steam material which occasion requires,* and the best method of introducing and distributing steam in the retort or cylinder is by means of perforated pipes.

Steaming of ties, timber and lumber is apparently not injurious to the wood, if the work is conducted intelligently and within certain limits of temperature and duration.

It is difficult to inject any considerable quantity of preservative into green ties and timbers unless given a preliminary steaming or boiling in oil. One of the principal factors, influencing the absorption of any kind of preservative, is the moisture content of the wood—the drier the wood the more it will absorb, consequently the more thorough the treatment.

The object of steaming is to put the wood in a condition to secure the maximum penetration with the desired amount of preservative, and admits of the immediate treatment of green or fresh cut material.

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Theoretically, steaming of green material preliminary to air seasoning should materially reduce the period of air seasoning.

*In steaming, the pressure should at no time exceed 20 lbs. per square inch, nor the oil temperature in boiling exceed 200° F. with possible exceptions in the case of some Pacific Coast timbers which may require higher temperatures.*

During the process of steaming a considerable amount of condensed steam remains in the wood, which to some extent resists the entrance of the fluid. The liberating of this condensation, after steaming, may be accomplished by subsequent drying in open air or in drying ovens or by applying a vacuum.

### D.—Treatment of Timber.

#### 1. Preservatives.

Coal-tar creosote and zinc chloride are the standard materials used in preserving timber.

#### 2. Processes.

FULL-CELL.

This form of treatment under the name of the Bethell process has been used extensively for years. It is essentially the impregnation of wood with practically all of the creosote it will hold, thereby giving the maximum protection. For many purposes this treatment is too expensive, and, we, therefore, make the following recommendations for its use:

*The Committee recommends the use of the full-cell process for piles and other marine timbers where subject to attack of the teredo and other marine borers, and that in such situations an injection of at least 20 lbs. per cubic foot, or treatment to practical refusal, should be given; while in marine and land situations where decay is the principal source of failure, treatments may range down from 20 to 10 lbs. per cubic foot by the same process, the injection in all cases to be sufficient to penetrate all the sapwood.*

*We further recommend the full-cell treatment in permanent structures not subject to mechanical wear when conditions of moisture, climate or humidity are favorable to wood-destroying fungi, and particularly where the cost of renewals or replacement would be high.*

EMPTY-CELL.

Empty-cell treatment with creosote aims to reduce materially the final retention of creosote per cubic foot, giving at the same time depth of penetration.

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The two recognized empty-cell processes base their patent features on fundamentally different means of attaining the same end. One of these requires an initial air pressure which is held during the introduction of the creosote, and the application of the pressure necessary to force it into the wood. When the oil is withdrawn from the treating cylinders and the pressure reduced to sub-normal by a vacuum, the initial air in the wood forces out the surplus creosote. With the other process, a quick high final vacuum is depended upon to recover the surplus oil. By each of these processes a maximum depth of penetration with a final retention of 5 to 8 lbs. of oil per cubic foot is claimed. With some species of wood even smaller quantities of oil may be fully distributed.

With the growing realization that it is entirely useless to preserve timber from decay beyond its mechanical life, empty-cell treatments have rapidly grown in favor and are used by several of the largest railroad systems. While definite deductions may be drawn from theoretical consideration of the two processes and divergent opinions are held, it is not for the Committee to pass judgment, and the fact remains that both processes have received wide recognition.

The essential fact entitling any empty-cell process to recognition, or approval, is that there be an appreciable recovery, usually a minimum of 40% of the oil injected, and that initial penetration before recovery of the surplus be entirely through the treatable portions of the stick; that is, through the sapwood, and at least superficially in the heartwood, the extent of the latter depending on the species. It should be remembered that an average of 5 lbs. per cubic foot may mean a retention of 8 to 10 lbs. per cubic foot in the treatable portions where most needed.

The Committee finds the empty-cell treatment suitable for all pine and other easily treated cross-ties used in moist climates, under service conditions which give a mechanical life in keeping with the anticipated life from decay; also for structures of limited life, or subject to superficial mechanical wear, and elevated so as to be exposed mainly to the wood-destroying influences of weather conditions.

*In all outside situations it is recommended that a maximum injection of creosote, or sufficient to insure the penetration of all treatable wood, be required and that not less than an average of 5 lbs. of creosote per cubic foot be left in the treatable portions of the wood; while it is urged as a definitely specified requirement, that at least all of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated, and the depth or extent of the penetration be equal to that of the full-cell treatment.*

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To insure uniform bearing surface and maximum penetration under the rail seat, all creosoted ties should be bored and adzed before treatment. Although sawn ties may have a uniform surface, the boring increases the penetration at the point it is most needed.

ZINC CHLORIDE.—*It is recommended where zinc chloride alone is used treatment be by the standard process known as "Burnettizing," and that a full impregnation which will insure the retention of a minimum of ½ lb. of dry salt per cubic foot of timber be given.*

*We suggest zinc chloride treatment in arid and semi-arid regions, particularly for cross-ties and other material with mechanical life limited to the expectation of life from decay and checking. It should not be used where mechanical wear is eliminated, nor in situations where the treated timber is in permanent or intermittent contact with either stagnant or flowing water. Consideration should also be given to its use on overhead trestles and similar structures.*

*Under usual conditions three months' seasoning after treatment is advisable.*

CREOSOTE-ZINC CHLORIDE.—The use of creosote and zinc chloride in mixture, was started in Germany by Rutgers in 1874. A special creosote was used which remained in mixture with the zinc chloride solution under working conditions.

Rutgers guaranteed that 95% of the ties which he treated by this method would give a minimum of ten years' service in the track. He accepted a penalty if the ties failed in less than ten years, and received a bonus for the life in track in excess of his ten-year-guarantee.

Results obtained from Rutgers process in Germany would indicate a life of ties prepared by the zinc-creosote process, principally pine, of from 12 to 18 years.

The most widely recognized use of this combination in America is a process whereby the creosote and zinc chloride, since they are of different specific gravity, are mixed during treatment by means of a centrifugal pump. A two-movement application of the two preservatives has also been used to a limited extent. In both cases the procedure is based on mechanical methods and not upon process of injection.

This method has been used in America since 1907. Evidence is at hand indicating satisfactory service from timber treated by this process. The records are still incomplete for the reason that the timber is still in service.

*Creosote-zinc in mixture is fundamentally effective because composed of the two most widely accepted preservatives. In situations where the mixture is preferable to a single preservative, it should be*

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*used according to the judgment of the consumer as to its greater economy and efficiency under local conditions.*

A. R. JOYCE, *Chairman*
J. B. CARD
O. P. M. GOSS
F. R. MARTIN
GEO. E. REX
LOWRY SMITH
E. A. STERLING
C. P. WINSLOW.

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## DISCUSSION OF REPORT OF COMMITTEE ON THE PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

**By F. S. Pooler.**

This report is so interesting I would gladly discuss it a paragraph at a time, but can only hit the high spots in a paper of this length. In these days no one questions the importance and value of wood preservation, and it goes without saying that what is worth doing at all is worth doing well.

It is interesting to observe the evolution of the treating plant during the last few years. More attention is being paid to the proper piling and seasoning of timber; to the proper grading and drainage of the ground it is piled on, and also to the classification of the various kinds of timber to be treated. Many of the yards are now laid out with mathematical precision; all grass, weeds, rubbish, and decaying wood are cleared away and destroyed, and these yards are in a sanitary condition. Does it pay to do this? I believe it pays one hundred cents on the dollar. One of the greatest benefits brought about by this change is the protection of the untreated timber during the seasoning period. A clean tie yard is sure to be a healthy tie yard, and not the least important consideration is its influence on the prospective purchaser of the material. When we go into such a yard we know that the plant is being run on business principles and that someone there takes a pride and interest in doing the work well.

Viewing this subject from the standpoint of the purchaser and consumer suggests further important improvements that may be made. For instance, how many treating plants can tell in what month their timber was cut? Consequently, it is largely a matter of guess work He has an inspector at the plant, but that inspector can only guess at the condition of the timber by general appearance the same as the plant operator does. Occasionally the inspector is able to weigh a charge of timber, and after it has been treated and the weight per cubic foot before and after treatment has been figured out, we can tell whether

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is bright and new, it is piled up, and what recourse has the purchaser? as to how long it has been seasoned. If it looks dry it is treated. If it or not it was a mistake to have it treated at all.

These weighing tests are instructive, and plant superintendents try to be accommodating, but as they increase the cost of operation it is not to be expected they will be regarded with great enthusiasm.

These are the conditions at most treating plants today as far as my experience goes, but you say: "If the purchaser wants to be sure his timber is properly seasoned, why doesn't he buy the timber and pile it up at the plant until he is satisfied it is fit to treat?" But I ask you: "Why should a railroad company, or other purchaser, have to go into the market in competition with the tie-company in order to regulate the seasoning period of its timber?" Why should not the treating plant get this most important matter lined up in a way satisfactory to its customers?

Then comes the question, would the purchaser be willing to pay the additional cost of marking and sorting the ties in order to have the timber in proper condition before treatment? My idea is they should be willing to pay part of this expense. We are always willing to pay what a thing is worth, and do not expect to get it for less.

Much could be done at a small additional expense. Cross-ties in tended for treatment could be marked with dating hammers, preferably at the time they are made, or, when this cannot be done, then when they are purchased by the treating companies. These hammers could be made with detachable dies or stamps to be keyed into the face of the hammer—one stamp for each month of the year. The face of the hammer could also bear the permanent brand of the maker or treating-company.

Some sorting is always necessary at a tie plant. Railroads that have treating plants sort all their ties, and figure that it pays them to do so. Unless something of this kind is done, we are simply working in the dark as far as the seasoning period is concerned, and these seasoning specifications do not amount to much. What is the use of specifications unless they are lived up to.

In regard to the use of "S" irons to prevent checking mentioned on the tenth page of the report: These are efficient if made large enough, and applied promptly after the check appears. Our Company makes its own "S" irons. They are made from strips of iron ⅛ in. thick, ¾ in. wide, beveled on one edge, bent into the form of a letter "S" 7 in. in length over all. We used them smaller at first, but found they would not hold.

It would be interesting to have some of the plant operators tell us why more accuracy is not used in determining the seasoning period of treatment timber.

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## SEASONING TIMBER.

By R. H. Rawson.

The chief feature of any seasoning method, whether it be natural or artificial, is to reduce the moisture content to such a point that the wood can be easily penetrated with the preservative, at the same time causing a minimum loss in strength.

The steaming process is used with good success at some plants on the Pacific coast, but the writer's experience has been confined to the old boiling process and boiling under vacuum. I will therefore confine this discussion only to the boiling under vacuum. The Committee's report does not cover this method of seasoning, but a very thorough discussion was made at the last meeting of this Association after Mr. Goss's paper was presented. (See PROCEEDINGS for 1916, pages 71 to 84.)

The method of boiling under a vacuum, wherever it has been used on the Coast, has proven successful. The prevailing practice is to use, for lumber and timber, a temperature of about 190° F. with a 26 in. vacuum, while for green piling a temperature of about 210° F. and the same conditions of vacuum are used.

To me the boiling under vacuum process brings up three main points for consideration, namely, (1) the average degrees above boiling, (2) the time and (3) the surface area per cubic foot. The degrees above boiling and the time are factors we can control, so the only variable we have in different retort charges is the surface area per cubic foot.

In order to work out a scheme to determine when the wood is in the proper condition to start pressure, we dry down to what we call a "finishing rate of dryness"; in other words, we figure the amount of condensation that must come off during the last hour of the bath on the basis of a certain percentage of a pound of water per cubic foot of material. We will say, for example, that our experience and experiments have shown us that our finishing rate of dryness should be 0.1 lb. of water per cubic foot per hour for 8x16 timber. Knowing the cubature of the charge under consideration, it is easy to compute the number of inches that must accumulate in the condenser during the last hour of the bath. When this point has been reached the wood is ready for pressure.

The question arises, what is the finishing rate for 2x12 plank under the same conditions of temperture and vacuum? Here the surface area per cubic foot must be considered, and by calculation we find that the 2x12 has 14 sq. ft. per cubic foot, and the 8x16 has 4.5 sq. ft. The correct finishing rate for 2x12 would be:

$$\frac{14}{4.5} \times 0.10 \text{ or } 0.311 \text{ lb. per cubic foot per hour.}$$

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In order to facilitate the comparison of the surface area per cubic foot the writer has prepared curves which show these values for various sized pieces, end area being neglected. In handling material other than Douglas fir, or with different classes of material, when the finishing rate has been worked out for given size piece, under the same conditions of temperature and vacuum, the proper rate for other sizes is easily determined by the use of this set of curves.

The writer has found that due consideration of the surface area, as outlined above, gives very good results in securing dry material, easy penetration and minimum loss of strength. The same consideration should be given in the case of seasoning piles, for it is obvious that the amount of moisture coming off from piles of small diameter will be greater per cubic foot than the amount removed from piles of larger diameters. The reason for this is that small piles have greater surface area per cubic foot than large piles.

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## THE TIE SUPPLY.

By O. C. Steinmayer.

### A. Fundamental Principles.

Statistics as printed in the PROCEEDINGS during the past year show that from 60% to 75% of all material treated in the past was in the form of cross-ties. That part of the recommendation for inclusion in the MANUAL, as follows:

> So far as practical, arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity.

if followed for cross-ties would prove an undue hardship on the tie producers, and would result in a big increase in the cost of the cross-ties.

By far the greatest production of ties is during the period, November to March, which hardly could be classified in the "seasons of minimum rainfall and humidity" in practically all sections of this country. Further, beech and gum ties, more especially the latter, if cut during the winter months, can be seasoned much more successfully than if cut at any other time of the year.

To me it seems advisable to eliminate that clause and substitute therefor a clause to the effect that all material should be moved to the seasoning yard as soon after cutting as practical.

### C. Preparation of Timber for Treatment.

The necessary width of the alley between piles is dependent upon the height to which the material is piled to get the best seasoning conditions and avoid loss through excessive checking because of too rapid seasoning.

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It seems advisable, therefore, that the minimum width of the alley be made 3 ft., which will allow a person to get in between the piles and observe the condition of the end of the timber in the pile during the seasoning period.

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THE PRESIDENT: Gentlemen, as you all know, we have the banquet tonight. We will meet tomorrow morning at 10 o'clock.

An adjournment was then taken till January 25.

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## THURSDAY MORNING SESSION.
**January 25.**

The meeting was called to order by President Crawford at 10 o'clock A. M.

THE PRESIDENT: We will now have the report of the Committee on Service Tests of Wood-Block Paving. I will ask the Secretary to read the names of this Committee, and they will please take their places on the rostrum.

MR. F. J. ANGIER: Mr. L. B. Moses, Chairman, Mr. R. J. Calder, Mr. Allan W. Dow, Mr. E. G. Draper, Mr. E. R. Dutton, Mr. R. S. Manley, Mr. Phil R. Smith, Mr. J. C. Williams and Mr. Geoffrey Winslow. The report will be presented by Mr. Williams.

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## REPORT OF COMMITTEE ON SERVICE TEST OF WOOD BLOCK-PAVING.

*To the Members of the American Wood-Preservers' Association:*

The instructions from the Executive Committee for the guidance of this Committee were as follows:

1. Continue a compilation and tabulation of all data which can be secured on service tests of blocks in streets, bridges and floors indicating in each the kind of wood and method of treatment, and all other data which will be of value.

2. Point out what species of wood, and what character of treatment, service records or data are lacking.

3. Make further recommendations as to how additional data may be effectively procured.

4. Present recommendations for future work to be undertaken by your Committee.

The report of Committee No. 6, presented at the 1916 meeting, included the following paragraphs:

"The next Committee, however, should not confine their analysis and investigations to the successful pavements alone."

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And the Chairman of this year's Program Committee, in transmitting the instructions quoted above, also stated as follows:

> "You are not restricted to report on satisfactory pavements only, in fact, a study of failures in wood-block pavement should prove profitable, since experience teaches us most when we learn what to avoid."

Through an unfortunate combination of circumstances no work had been done by this Committee up to the middle of October, so at the request of the Chairman of this year's Program Committee the three members from the Atlantic Coast Region have endeavored in the short time remaining to collect data and carry out the various instructions given to the Committee. To accomplish this, circular letters were sent to all cities tabulated in the supplemental report of the Wood-Block Paving Committee for 1915. Up to the writing of the report we have received answers from about half of the cities to which circular letters were sent. This circular letter inquired for special detailed information on three specific streets, namely:

1. The oldest wood-block pavement.
2. The best wood-block pavement, regardless of age.
3. The pavement that has either failed or been most unsatisfactory.

The information requested on these three streets was:

Name of street.
Approximate yardage of the wood-block pavement.
Date when street was paved.
Kind of wood used.
Texture of the wood (rings per inch).
Size of the block used.
Amount of oil injected to the cubic foot of wood and the character of the oil used with analysis, if possible.
Character and depth of foundation.
Kind and depth of cushion used.
Kind, width and number of expansion joints used.
Character of material used for filling joints between the blocks.

Detailed information regarding the treatment of the blocks, including the condition of the wood when treated, the duration and temperature of preliminary heating and steaming, the amount and duration of vacuum, the temperature and amount of oil used and the approximate pressure and length of time in applying the oil, whether the blocks were subjected to further steaming after the treatment or to supplemental vacuum, and, if so, under what conditions.

In addition to these, in inquiring about the street which had failed or was unsatisfactory, we requested information as to what way the street had failed or was unsatisfactory, what in the idea of the engineer caused the failure, and what he would suggest to remedy the defect.

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A compilation of the answers received as to the oldest pavement is given below, arranged chronologically and also classified as to the kind of wood. The first few of the pavements mentioned have not been reported on this year, but our information has been taken from previous reports and from the report of the Wood-Block Paving Committee of 1915.

19 YEARS.—LONGLEAF YELLOW PINE.

**Indianapolis, Ind.** 60,439 sq. yds. laid in 1898; reported in bad condition, 1914. No report received by this year's Committee.

18 YEARS.—LONGLEAF YELLOW PINE.

**Indianapolis, Ind.**—7,863 sq. yds. laid in 1899; reported in bad condition, 1914. No report received by this year's Committee.

17 YEARS.—LONGLEAF YELLOW PINE.

**Boston, Mass.** (Tremont Street).—1295 sq. yds. laid in 1900; still in service and in excellent condition, 1917. Treated with a mixture of rosin and creosote.

**Geneva, N. Y.** (Lake St.)—Laid in 1900; 4 ins. x 10 ins. x 4 ins. deep, treated with creosote; quantity and type of oil not reported. Six ins. concrete foundation, sand cushion, bituminous-paving joints; no expansion joints. Blocks are said to have been steamed, but no other details of treatment are known. Pavement is still in service, cost of maintenance, not known.

17 YEARS.—FIR.

**Spokane, Wash.**—1144 sq. yds. laid in 1897; reported replaced in 1914. Blocks were merely dipped in creosote and received very little penetration.

16 YEARS.—LONGLEAF YELLOW PINE.

**Indianapolis, Ind.**—35,774 sq. yds. laids in 1901.

**Boston, Mass.**—11,684 sq. yds. laid in 1901.

**Youngstown, Ohio.**—2,900 sq. yds. laid in 1901. (This is a bridge floor.)

The Indianapolis yardage is in fair condition, and the yardage in the other two cities is still very good.

**Springfield, Mass.,** (Main St. from Lyman St. to Liberty St.)—2780 sq. yds. laid in 1901 4 ins. x 8 ins. x 4 ins. blocks; 21 to 22 lbs. treatment, creosote and rosin mixture. About one-half of this yardage has since been relaid by the city. Wood block wears out under traffic in Springfield in about 10 years. This pavement is on 6 ins. of natural cement concrete, 1 in. sand cushion, sand and pitch-paving joints, pitch in the upper part. No expansion joints. Partly air-seasoned lumber, not steamed. 26 ins. vacuum at 175° to 200° F. Oil pressure, 200 lbs. at 150° F. Final bath of milk of lime.

15 YEARS.—LONGLEAF YELLOW PINE.

**Toledo, O.**—6,601 sq. yds.

**Manhattan, N. Y.**—1,152 sq. yds.

**Minneapolis, Minn.,** (10th St. from 1st. Ave. South to Park Ave.).—13,304 sq. yds. laid in 1902. Texture of wood was mixed but fairly good. 4 ins. x 6 ins. to 10 ins. x 4 ins. deep blocks. 12-lb. treatment Kreodone oil. 6 ins. natural cement concrete foundation, 1 in. sand cushion. Pitch-paving joints, 1 in. pitch-expansion joints at curbs. Details of treatment not known. Pavement still in service.

15 YEARS.—FIR.

**Seattle, Wash.**—1,227 sq. yds., partly replaced.

14 YEARS.—LONGLEAF YELLOW PINE.

**Brooklyn, N. Y.** (Monroe St., from Nostrand Ave. to Marcy Ave.).—3,262 sq. yds. laid in 1903. 4 ins. x 8 ins. x 4 ins. deep blocks; quantity of oil not known, probably 20 lbs. Oil was 50% creosote and remainder rosin or other suitable waterproofing material. 4½-in. concrete foundation, ½-in. mortar cushion; 1:4. Sand-paving joints. No expansion joints; still in service. Has cost city 10.6 cents per sq. yd. since out of guarantee in 1908.

**Chicago, Ill.** (Taylor St., Canal to Blue Island Ave.)—7,540 sq. yds. laid in 1903 and 1904, minimum 6 rings. 4 ins. x 6 ins. to 10 ins. x 4 ins. deep blocks; 12-lb. treatment, Kreodone, creosote, paving oil. 6 ins. Portland cement foundation, 1-in. sand cushion. Bituminous cement-paving joints. 1 in. bituminous cement-expansion joints at curbs. ½-in. transverse joints at

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100-ft. intervals. Lumber partly air-seasoned. Blocks were steamed at 200° to 225° F. for 1½ hours; 20-in vacuum at 210° to 145° F. for 1¾ hours. No final steaming or vacuum. About 462 sq. yds. have been repaired up to Nov. 1, 1916.

(Many other cities are know to have had wood blocks in service since 1904. Some of these will be found on pages 337 to 364 of the 1915 Proceedings).

13 YEARS.—LONGLEAF YELLOW PINE.

**Borough of Manhattan, N. Y.**—Laid in 1904. Cortlandt St., Broadway to West St., 3,387 sq. yds. 7% of surface repaired in 1914 and 1915.

Murray St., Broadway to West St., 6,176 sq. yds. 8% of surface repaired in 1914 and 1915.

20th St., Broadway to 5th Ave., 988 sq. yds. 4% of surface repaved in 1915.

98th St., Central Park West to Amsterdam Ave., 5,521 sq. yds. 1% of surface repaired in 1915.

12 YEARS.—LONGLEAF YELLOW PINE.

Borough of Richmond, N. Y. (Canal St., from Wright St. to Broad St.).—3,471 sq. yds. laid in 1905; heart timber. 3 ins. x 8 ins. x 4 ins. blocks. Treated to weigh 62½ (plus) lbs. per cu. ft. Oil analysis not reported. 6 ins. concrete foundation, 1 in. sand cushion. Sand-paving joints; 1 in. bituminous-paving joints at curbs. No details of treatment or oil available. No maintenance expense to Nov. 1, 1916.

**Borough of Queens, N. Y.** (Metropolitan Ave., from Borough line to Helen St.)—12,165 sq. yds. laid in 1905, all heart. 3 ins. x 8 ins. x 3½ ins. deep blocks. Quantity of oil not reported, probably 20 lbs. per cu. ft. Oil was 50% creosote and 50% rosin. 6 ins. concrete foundation, 1½ ins. cement mortar cushion. Sand-paving joints. No record of condition of lumber. Blocks were subjected to dry heat up to 215° F. for one hour, heat was then increased to 285° F. No other details of treatment reported. No record of maintenance expense kept.

**Detroit, Mich.** (Catherine St., from Chene St. to Jos. Campau St.).—2,062 sq. yds. laid in 1905. Minimum 7 rings per inch. 3 ins. to 4 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. or 20-lb. treatment. No oil analysis reported. 6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1½ ins. tar-expansion joints at curbs. No report of details of treatment. No report of cost of maintenance.

**Borough of Manhattan, N. Y.** (Duane St., Broadway to West St.).—7,648 sq. yds. laid in 1905. 6% of repairs in 1913, 1914 and 1915.

East Broadway, Chatham Square to Grand St., 19,379 sq. yds. 6% of repairs in 1913, 1914 and 1915.

Hudson St., Jay St. to Worth St., 1060 sq. yds. 4% of repairs in 1913 and 1914.

Jefferson St., Henry St. to East Broadway, 627 sq. yds. No repairs up to 1915.

John St., Nassau to Broadway, 888 sq. yds. No repairs up to 1915.

Liberty St., Broadway to West St., 3,040 sq. yds. 3% repairs in 1913 and 1914.

(List of other cities having 12-year old pavements will be found in the 1915 Proceedings.)

11 YEARS.—LONGLEAF YELLOW PINE.

**Kansas City, Mo.** (Admiral Boulevard from Grand Ave. to Cherry St.).—6,860 sq. yds. laid in 1906. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. treatment creosote of specific gravity 1.09. Oil analysis not reported. 5 ins.-1.3.7 Portland cement foundation. 1 in. sand cushion. Sand-paving joints. 1 in. tar-expansion joints at curbs. Transverse joints every 200 ft. No details of treatment reported. No maintenance expense reported.

The following streets in the Borough of Manhattan, N. Y., laid in 1906 with longleaf yellow pine blocks, have required but a small percentage of repairs:

Barclay St., Broadway to West St., 5,272 sq. yds. 4% of surface repaired up to 1915.

Beekman St., Nassau St. to Park Row, 650 sq. yds. No repairs up to 1915.

Old Slip, Front St. to Water St., 1,356 sq. yds. No repairs up to 1915.

Park Place, Broadway to West St., 6,499 sq. yds. 2% of surface repaired in 1915.

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**West Broadway, Dey St. to 4th St., 28,746 sq. yds. 8% of surface repaired in 1913, 1914 and 1915.**

**Worth St., Broadway to Church St., 1,644 sq. yds. No repairs up to 1915.**

**10th St., Hudson to West St., 2,525 sq. yds. No repairs up to 1915.**

**(List of other cities having wood-block pavements 11 years old will be found in the 1915 Proceedings.)**

### 11 YEARS.—TAMARACK.

**Austin, Minn,** (Bridge St., from Main St. to St. Paul St.).—1,173 sq. yds. laid in 1906. 3½ ins. deep blocks. 16-lb. treatment. No report of type of oil. 5 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ¾ in. pitch-expansion joints at curbs. No details of treatment reported. Has cost $2.50 maintenance to Nov. 1, 1916.

### 10 YEARS.—LONGLEAF YELLOW PINE.

**Bridgeport, Conn.** (Fairfield Ave., from Park Ave. to Clinton Ave.).—13,700 sq. yds. laid in 1907. Texture of wood, minimum 5 rings per inch. 3 ins. x 5 ins. to 8 ins. x 3½ ins. deep blocks. Treatment and type of oil not reported. 6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. pitch-expansion joints at curbs. ½ in. transverse joints every 75 ft. No details of treatment reported. No record kept of cost of maintenance.

**Borough of Manhattan, N. Y.**—Two streets were paved with wood blocks in 1907: Bowling Green from Whitehall to State St., 1,134 sq. yds., and Bridge St., from Whitehall to State St., 744 sq. yds. No repairs were made on either of these streets up to 1915.

**(List of other cities having wood-block pavements 10 years old will be found in the 1915 Proceedings.)**

### 9 YEARS.—LONGLEAF YELLOW PINE.

**New Haven, Conn.** (State St., from Grand St. to Chapel St., also Court St., Center St., Meadow St., from Congress St. to Water St., Church St., from George St. to Chapel St.)—Total 17,000 sq. yds. laid in 1908. 3 ins. x 8 ins. x 3 ins. deep block, 90% heartwood, 20-lb. treatment, rosin and creosote mixture, at least 75% creosote.

Oil Analysis:

| | |
|---|---|
| Specific gravity at 68° F. | 1.12 |
| Loss on distillation up to 315°C. | 22.53% |
| Total loss on distillation up to 350°C. | 27.53% |
| Suspended matter insoluble in benzol | 2.50% |

Oil conformed to the specification requirements. 6 ins. 1.3.6 Portland cement concrete foundation. Mortar cushion (sand has since been used.) Sand-paving joints. ½ in. bituminous-expansion joints at curbs. Transverse joints were originally put in at 100 ft. intervals. These not appearing to be necessary were later removed, and the space filled by relaying two or three courses with wider blocks. Blocks were subjected to live steam for 3 hours at an average temperature of 220°F. Vacuum, 24 ins. for an average of 2 hours. Oil injected at average maximum temperature of 170°F. Pressure maintained for an average of 4½ hours. Average maximum pressure, 200 lbs. Very little maintenance expense on these streets, and that merely next to street-car tracks, especially at street intersections.

**Philadelphia, Pa.** (Market St., from 2nd St. to 23rd St.).—80,000 sq. yds. laid in 1908 and 1909. 4 ins. x 8 ins. x 4 ins. deep blocks, 90% heartwood, minimum 20-lb. treatment specified, rosin and creosote mixture: 75% oil, 25% rosin. Inspector's report shows 22 to 25 lbs. of oil were injected.

Oil Specification:

| | |
|---|---|
| Minimum specific gravity at 25°C. | 1.10 |
| Pure coal-tar product, free from oil-tar or water-gas tar products. | |
| Maximum insoluble in benzol | 5% |

Distillation:

| | |
|---|---|
| Maximum up to 150°C. | none |
| " " " 210°C. | 10% |
| " " " 235°C. | 20% |
| " " " 315°C. | 35% |
| " " " 370°C. | 50% |

5½ ins. concrete foundation, ½ in. mortar cushion. Cement-grout paving joints. ¾ ins. to 1 in. expansion joints along the curbs. Details of treatment: Blocks were subjected to live steam 5 hours at temperature 240 to 260°F.;

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vacuum, 13 ins. to 25 ins. for ½ hour. Oil injected at average maximum temperature of 212°F. Oil pressure maintained 3 to 7 hours; average maximum pressure, 175 lbs.

**Pittsburgh, Pa.** (Cecil Place, from Liberty St. to Penn. Ave.).—374 sq. yds. laid in 1908. 4 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 20-lb. treatment, rosin and creosote mixture, 75% or less oil and 25% rosin. Oil analysis not reported. 6 ins. concrete foundation. ½ in. 1:4 mortar cushion. Air-seasoned lumber. No details of treatment reported.

WHITE PINE, NORWAY PINE AND TAMARACK.

**Grand Forks, North Dakota,** (3rd St., from Belmont to Ione St.).—3¼ ins. deep blocks, 20-lb. treatment.

Oil Analysis:

| | |
|---|---|
| Specific gravity at 20°C | 1.119 |
| Distillation: | |
| Up to 150°C | none |
| " " 170°C | 0.5% |
| " " 210°C | 3.2% |
| " " 235°C | 16.8% |
| " " 315°C | 43.9% |
| " " 355°C | 55.4% |

6 ins.—1.3.6 concrete foundation, screened gravel aggregate. 1½ ins. sand cushion. Tar-paving joints. Tar-expansion joints at curbs. Transverse joints every 100 ft. No preliminary steaming of blocks. 22 ins. vacuum for 1½ hours. Oil pressure maintained for 4¼ hours. Maximum pressure, 160 lbs. Temperature of oil, 205°F. maximum. The maintenance expense on this pavement has been practically nothing, except along the street-car rails.

8 YEARS.—TAMARACK AND NORWAY PINE.

**Albert Lea, Minn.** (Broadway, from Water St. to Pearl St.).—10,300 sq. yds. laid in 1909. 4 ins. x 4 ins. to 9 ins. x 3 ins. deep blocks. 16-lb. treatment. No record of oil analysis. 5 ins concrete foundation. 1 in. sand cushion. Bituminous-paving joints. 1½ ins. bituminous-expansion joint at the curbs. No details of treatment on record. No exact record of maintenance. There has been some slight expense for repairs on account of heaving.

7 YEARS.

**Clinton, Iowa** (3rd St., from 3rd Ave. to 4th Ave., and 3rd Ave., from 3rd St. to 4th St.).—4,570 sq. yds. of 3-in. deep wood block laid in 1910. 20-lb. treatment. The kind of wood is not stated. Blocks are laid on 5 ins. of concrete with 1-in. sand cushion and asphalt-paving joints. 2 ins. asphalt-expansion joints at the curbs. No details of treatment reported.

7 YEARS.—LONGLEAF YELLOW PINE.

**East St. Louis, Ill.** (Vogel Place, from State St. to College Ave.)—4,700 sq. yds. laid in 1910. 3¾ ins. x 6 ins. to 10 ins. x 3 ins. deep blocks, 6 rings per inch. Specific gravity of oil specified, 1.10 minimum. 5 ins. concrete foundation. 1 in. sand cushion. Coal-tar pitch-paving joints. 1 in. coal-tar pitch-expansion joints at the curbs. No details of treatment at hand. Cost of maintenance not reported.

7 YEARS.—TAMARACK.

**Faribault, Minn.** (Central Ave., Division St. intersection).—528 sq. yds. laid in 1910. 4 ins. x 5 ins. to 8 ins. x 3 ins. deep blocks. 16-lb. treatment. No oil analysis reported. 5 ins. concrete foundation. 1 in. sand cushion. Tar-paving joints. 1 in. tar-expansion joints at the curbs. No details of treatment reported. Maintenance has been nil.

6 YEARS.—LONGLEAF YELLOW PINE.

**Watertown, N. Y.** (High St., from State St. to Factory St.).—6,000 sq. yds. laid in 1911. 3 ins. deep blocks. Texture not reported. 20-lb. treatment. Oil analysis not reported. 5 ins. concrete foundation, ½ in. sand cushion. Sand-paving joints. Paving pitch-expansion joints at curbs. No report of condition of lumber, or details of treatment.

**Memphis, Tenn.** (Madison St., from Front St. to Poiningo St.).—10,117 sq. yds. laid in 1911. 4 ins. x 5 ins. to 10 ins. (average 8 ins.) x 3½ ins. deep blocks. Minimum, 6 rings per inch. Coal-tar oil, minimum gravity, 1.10 at 38°C. 6 ins. concrete foundation. 1 in. to 2 ins. sand cushion. Pitch-paving joints. 2 ins. pitch-expansion joints at curbs. ½ in. pitch-transverse joints, every 50 ft. Lumber was green, and blocks were steamed before treatment. No other details of treatment reported.

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**Wichita Falls, Tex.** (7th St., from Ohio St. to Alley West of India St.)—Laid in 1911. 4 ins. x 8 ins. x 3 ins. deep blocks—Minimum 6 rings per inch. 20-lb. treatment. Oil analysis not reported. 5 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. Asphalt-expansion joints at curbs. Asphalt-transverse joints every 25 ft. No details of treatment. No record of maintenance expense.

**Cedar Rapids, Iowa.** (16th Ave. Bridge, from 1st St. East to A St. West.).—3,000 sq. yds. laid in 1911. 4 ins. x 5 ins. to 10 ins. x 3 ins. deep blocks. 6 rings per inch. 16-lb. treatment with coal-tar creosote. 5 ins. concrete foundation. ¾ ins. cement mortar cushion. Bituminous-paving joints. 1 in. bituminous-expansion joints at curbs. No details of treatment reported. No expense for maintenance up to Nov. 1, 1916.

6 YEARS.—NORWAY PINE AND TAMARACK.

**Rochester, Minn.** (Broadway, from College St. to Ninth St.).—22,000 sq. yds. laid in 1911. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 6 rings per inch. 16-lb. treatment with coal-tar product. 5 ins. concrete foundation. 1 in. sand cushion. Bituminous-paving joints. 1 in. paving pitch-expansion joints at curbs. No details of treatment reported. Cost of maintenance has not been anything.

5 YEARS.—LONGLEAF YELLOW PINE.

**Petersburg, Va.** (East Bank St., from Sycamore St. to Second St., and Second St., from East Bank St. to Boiling Brook St.).—2,200 sq. yds. laid in 1912. 3½ ins. deep blocks. Minimum 4 rings, average 8 rings per inch. 16 to 18-lb. treatment with coal-tar creosote of specific gravity 1.03 to 1.14 at 38°C. 4 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. clay-expansion joints at curbs. No details of treatment reported. Cost $25.00 for maintenance up to Nov. 1, 1916.

**Fort Smith, Ark.** (Garrison Ave., from First St. to 13th St.).—35,000 sq. yds. laid in 1912. 3½ ins. deep blocks. Minimum 6 rings per inch. 16-lb. treatment. Oil analysis not reported. 8 ins. concrete foundation. 1 in. sand cushion. Bituminous-paving joints. ½ in. bituminous-expansion joints every 50 ft. transversely. No details of treatment reported. Up to Nov. 1, 1916, $125.00 has been spent for maintenance on account of bulging.

**St. Paul, Minn.** (5th St., from Wabash to St. Peter, and from Cedar to Jackson.)—4,213 sq. yds. laid in 1912. 4 ins. x 5 ins. to 10 ins. x 4 ins. deep blocks. Average not less than 6 rings per inch. 16-lb. treatment with tar creosote. 5 ins. Portland cement, concrete foundation, 1 in. sand cushion. Bituminous-paving joints. 1½ ins. pitch-expansion joints at curbs. No details of treatment reported. Cost nothing for maintenance up to Nov. 1, 1916.

**Providence, R. I.** (Exchange St., from Westminister St. to Exchange Place).—550 sq. yds. laid in 1912. 4 ins. x 8¼ ins. x 3½ ins. deep blocks. Texture of wood and quantity of oil not reported. 6 ins. or over cement-concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. specification "B" pitch-expansion joints at curbs. No details of treatment reported. Cost nothing for maintenance up to Nov. 1, 1916.

## WOOD-BLOCK PAVEMENTS REPORTED BY DIFFERENT CITIES AS BEING THE BEST AND MOST SATISFACTORY UP TO JANUARY 1, 1917.

LONGLEAF YELLOW PINE.

**Paved In 1910.**

**New Haven, Conn.** (State St., from Chapel St. to Water St.).—This street is typical, others are practically as good. 5,125 sq. yds. Minimum, 6 rings. 3 ins. x 8 ins. x 3½ ins. deep blocks. 20-lb. treatment with coal tar-paving oil. Analysis as follows:

| | |
|---|---|
| Specific gravity at 38°C. | 1.168 |
| Insoluble in benzol | 2.5 % |
| Water | 1.0 % |

Distillation:

| | |
|---|---|
| Up to 150°C. | 0.6% |
| 150 to 255°C. | 13.9% |
| 255 to 305°C. | 9.9% |
| 305 to 315°C. | 1.8% |
| Total to 315°C. | 26.2% |

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Specific gravity of fraction 255° to 315°C.....1.049
Unsulphonated residue fraction 305° to 320°C.....Trace

Distillates were all solid at 60°F., and the oil conformed to the specifications of the City of New Haven.

6 ins. 1.3.5 Portland cement concrete foundation. Sand cushion and sand-paving joints were used. ¾ in. bituminous expansion-joints at curbs, and ½ in. transverse joints made up in three joints at 100 ft. intervals. Blocks were subjected to dry heat at average temperature of 170°F., then live steam at 240°F. for an average of 3¼ hours. Vacuum 24 ins. for an average of 1½ hours. Oil injected at an average maximum temperature of 180°F. Oil pressure maintained 2½ hours average time at 160 lbs. average maximum pressure. No final steaming or vacuum. No expense for maintenance up to Nov. 1, 1916.

**Paved In 1911.**

**Chicago, Ill.** (California Ave., West Division St. to West North Ave. and others).—10,040 sq. yds. Minimum, 6 rings. 3¾ ins. x 5 ins. to 10 ins. x 4 ins. deep blocks. 16-lb. treatment. 6 ins. Portland cement-concrete foundation. 1 in. torpedo sand cushion. Sand-paving joints. 1 in. coal tar-paving pitch expansion joints at curbs. ¼ in. transverse pitch joints every 25 ft. Partly air-seasoned lumber. Steamed 1¾ hours at 215° to 225°F. Vacuum 20 ins. for 2 hours at 220°F. down to 150°F. No final steaming or vacuum. No expense for maintenance reported up to Nov. 1, 1916.

**Minneapolis, Minn.** (Park Ave., 28th to 34th Sts.).—15,135 sq. yds. 6 rings per inch. 4 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. treatment with tar oil.

Oil Analysis:

| | |
|---|---|
| Specific gravity at 38-15°C | 1.106 |
| Water | 2.1 % |

Distillation:

| | |
|---|---|
| Up to 150°C | 0.5 % |
| " " 170°C | 0.9 % |
| " " 210°C | 3.37% |
| " " 235°C | 13.89% |
| " " 315°C | 48.51% |
| " " 355°C | 55.36% |

5 ins. concrete foundation, 1 in. sand cushion. Bituminous-paving joints. 1 in. pitch-expansion joints at curbs. Partly air-seasoned lumber. Steamed 60 to 90 minutes. Vacuum, 26 ins. for 90 minutes, at 210°F. Final steaming when necessary to clean the blocks. No expense for maintenance up to Nov. 1, 1915.

**Delaware, O.** (Central St., Elizabeth St. to Campbell St.).—3,700 sq. yds. 90% heart. 3 ins. x 6 ins. to 8½ ins. x 3 ins. deep blocks. 16-lb. treatment.

Oil Analysis:

| | |
|---|---|
| Specific gravity at 38°C | 1.126 |
| Water | 2 % |
| Insoluble matter | 2.08 % |
| Total distillate up to 315°C | 34.5 % |

6 ins. 1.3.6 concrete foundation. 1 in. sand cushion. Bituminous-paving joints. 1 in. tar-expansion joints at curbs. 1 in. transverse tar joints at 50-ft. intervals. Dry heat in cylinders. No expense for maintenance up to Nov. 1, 1916.

**Paved in 1912.**

**Cambridge, Mass.** (Massachusetts Ave., Lafayette Square to Central Square and Quincy Square to Dunater St.)—26548 sq. yds. longleaf yellow pine. Average 8 rings per inch. 50% heartwood, 3 ins. x 8 ins. x 4 ins. deep blocks, and 3 ins. x 8 ins. x 3½ ins. deep blocks, 20-lb treatment, refined water-gas tar.

Oil Analysis.

| | |
|---|---|
| Specified gravity at 38°C | 1.128 |
| Insoluble in C. $S_2$ | 0.60 |

Distillation:

| | |
|---|---|
| Below 170°C | 0.50% |
| 170—205°C | 0.50% |
| 205—235°C | 1.70% |
| 235—255°C | 4.10% |
| 255—270°C | 5.80% |
| 270—315°C | 15.00% |
| 315—370°C | 24.60% |
| Residue | 47.80% |

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Condition of residue, hard.

| | |
|---|---|
| Insoluble in dimethyl sulphate | none |
| Specific gravity of distillate, 255° to 315°C at 60°C | 1.00 |

6 ins. concrete foundation, 1 in dry mortar cushion. Cement grout-paving joints. ½ in. Genasco asphalt-expansion joints at curbs. ½ in transverse joints of same material every 30 ft. Partly air-seasoned lumber. Steamed for 2 hours at 220° to 240° F. Vacuum, 20 ins. for 2 hours at 240° to 150° F. No final steaming or vacuum was applied. No expense for maintenance up to Nov. 1, 1916.

**Pittsburgh, Pa.** (East Ohio St., Federal St. to Chestnut St.)—6000 sq. yds. longleaf yellow pine, average 8 rings per inch. 3 ins. x 8 ins. to 10 ins. x 3½ ins. deep blocks—22-lb. treatment. 6 ins. concrete foundation. ½ in. mortar cushion. Bituminous-paving joints. 1 in. expansion joints at curbs. No expense for maintenance up to Nov. 1, 1916.

**Memphis, Tenn.** (Mulberry St., Beale to Calhoun Sts.)—9908 sq. yds. longleaf yellow pine, minimum 6 rings per inch. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 16-lbs. coal-tar oil. 6 ins. concrete foundation, 1½ ins. sand cushion. Bituminous-paving joints. 2 ins. pitch-expansion joints along curbs. Blocks were not steamed. No final vacuum; other details of treatment not reported. No expense for maintenance up to Nov. 1, 1916.

**Borough of Richmond, N. Y.** (Richmond Terrace, Nicholas St. to Stuyvesant Place.)—1458 sq. yds. longleaf yellow pine. 3 ins. x 8 ins. x 4 ins. deep blocks. 20-lb.treatment.

Oil analysis.

| | Sample No. 1. | Sample No. 2 |
|---|---|---|
| Specified gravity at 38°C | 1.087 | 1.059 |
| Napthalene (crystallizable) | 23.5% | over 40% |
| Phenol acids | 8.8% | 7.9% |

8 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. bituminous-expansion joints at curb. Condition of lumber and details of treatment not reported. No maintenance expense up to Nov. 1, 1916.

**Borough of Queens, N. Y.** (Jackson Ave., from Borden Ave. to Thompson Ave.)—19070 sq. yds. longleaf yellow pine, standard 1905 rules. 3 ins. x 8 ins. x 3½ ins. deep blocks, 20-lb. treatment. Oil analysis not reported. 8 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ½ in. paving pitch-expansion joints at curbs, along trolley tracks, and transversely every 200 ft. Condition of lumber and details of treatment not reported. No maintenance expense up to Nov. 1, 1916.

**Paved in 1913.**

**Bridgeport, Conn.** (Stratford Ave., Connecticut Ave. to City Line.)—29,500 sq. yds. longleaf yellow pine. Average 8 rings; minimum 5. 3 ins. x 5 ins. to 8 ins. x 3½ ins. deep blocks. 16-lb. treatment.

Oil Analysis.

| | |
|---|---|
| Specific gravity | 1.121 |
| Free carbon | 2.2% |

Distillation:

| | |
|---|---|
| Up to 150°C | 0.5% |
| " " 315°C | 37.0% |

Refined coal-tar and creosote.

6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints, ¾ in. asphalt felt expansion joints at the curbs. ½ in. transverse joints same material every 75 ft.

Lumber was air-dried to 40 lbs. per cubic foot. Blocks steamed before treatment. Temperature 240° to 244° F. for 2 or 3 hours. Vacuum then applied 23 to 25 in. No final steam or vacuum. No maintenance expense up to Nov. 1, 1916.

**Providence, R. I.** (Brook St., Benevolent St. to Lloyd Ave.)—8,289 sq. yds. longleaf yellow pine with minimum of 6 rings per inch. Blocks 3 ins. x 8 ins. x 3½ ins. deep. 18 to 21-lb. oil treatment. Oil used, coke oven tar and creosote mixture.

Oil Analysis.

| | |
|---|---|
| Specific gravity at 38°C | 1.133 |

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Distillation.

| | |
|---|---|
| Up to 255° | 19 % |
| 255°C to 315°C | 16 % |
| Specific gravity of fraction 255° to 315°C. @ 60°C | 1.031 |

No expense for maintenance up to Nov. 1, 1916.

**Charleston, S. C.** (Hasell St., King St. to Meeting St.)—1900 sq. yds. long leaf yellow pine. Average 6 rings per inch. 3 ins. x 8 ins. x 3 ins. deep blocks 16-lb. treatment.

Oil Analysis.

| | |
|---|---|
| Specific gravity at 38°C | 1.1037 |
| Free carbon | 3.5 % |

Distillation:

| | |
|---|---|
| Up to 150°C | 0.3 % |
| Up to 315°C | 37.8 % |

4 ins.—1.3.6 concrete foundation. 1 ins. sand cushion.

Sand paving joints. 1 in. bituminous-expansion joints at curb. Lumber mixed some green, some dry and some wet from rain, treated separately. Weight untreated 44½ to 45 lbs. per cubic foot. Steamed 3 hours at 240°F., then 22 ins. to 26 ins. vacuum for 3 hours. Oil injected at 110 to 140 lbs. pressure at 160° to 180°F. No supplementary steaming or vacuum. Average weight per cubic foot treated, 61 to 62 lbs.

Maintenance expense very little, if any, up to Nov. 1, 1916.

**Wichita Falls, Tex.** (Ohio St., 10th to 11th Sts.)—3,000 sq. yds. long leaf yellow pine. Minimum 6 rings. 4 ins. x 8 ins. x 3 ins. deep blocks. 16-lb. treatment. Oil analysis not reported. 5 ins. concrete foundation. 1 in. sand cushion. Bituminous paving joints. 1 in. asphalt-expansion joints at curb and every 25 ft. transversely. Details of treatment not reported. No expense for maintenance up to Nov. 1, 1916.

**Paved in 1914.**

**Petersburg, Va.,** (Perry St., Washington St. to Lawrence St.)—1200 sq. yds. yellow pine, minimum 4 rings; average 8. 3 ins. to 4 ins. x 5 ins. to 10 ins. x 3½ in. deep blocks. 16-to 18-lb. treatment. Creosote, 1.03 to 1.14 gravity at 38°C. Analysis not reported. 4 in. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. Clay-expansion joints at curb. Details of treatment not reported. No expense for maintenance up to Nov. 1, 1916.

**San Antonio, Tex.** (West Commerce St., Alamo St. to Soledad St.)—4700 sq. yds. outside of traction area. Longleaf yellow pine. Average 8 rings; minimum 5. Average 80% heart; minimum 50%. 3 in. x 6 in. to 8 ins. x 3½ in. deep blocks. 16-lb. treatment. No oil analysis reported. Pure coal tar distillate specified, to comply with the following requirements:

> Free from all adulteration and containing no raw tar, filtered or unfiltered tars or pitches, petroleum compounds, or other tar products.

| | |
|---|---|
| Specified gravity at 38°C | 1.03 to 1.08 |
| Maximum, insoluble in benzol and chloroform | 2 % |

Distillation.

| | |
|---|---|
| At 210°C | 5% Max. |
| " 235°C | 35% " |
| " 315°C | 86% " |
| Maximum coke residue | 3% |
| Maximum water | 3% |

Distillates 210°-235° C. shall yield solids on cooling to 15° C. 5 ins. reinforced 1.3.6 concrete foundation. ½ in.-1: 3 mortar cushion. Asphalt cement paving joints. 1½ in. expansion joints at the curbs. Details of treatment not reported or specified. No expense for maintenance reported to Nov. 1, 1916.

**Paved in 1915.**

**Kansas City, Mo.** (Walnut St., 7th to 12th St.)—6500 sq. yds longleaf yellow pine. Minimum 8 rings. 3⅞ ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. treatment.

Oil Analysis.

| | |
|---|---|
| Specific gravity | 1.12 |

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Distillation:

| | |
|---|---|
| Up to 100°C. | none |
| " " 150°C. | 1.10% |
| " " 235°C. | 12.98% |
| " " 315°C. | 37.77% |

8 ins. concrete foundation 1.3.6. Portland Cement. ½ in.-1 to 4 mortar cushion. Asphalt cement-paving joints. 1½ ins. expansion joints, same material at curbs only. Partly air-seasoned lumber, steamed under 10 to 20 lbs. pressure for 2 to 4 hours. Vacuum, 24 ins. for 2 hours at 240° to 160°F. No final steaming. 24 ins. final vacuum for one hour at 190° to 125°F. No maintenance expense up to Nov. 1, 1916.

**Brooklyn, N. Y.,** (Rockwell Place, Fulton St. to Lafayette Ave.)—This street is merely typical as many wood-block pavements in Brooklyn are identical in service. 1215 sq. yds. longleaf yellow pine. 7 rings per inch. 3 ins. x 8 ins. x 4 ins. blocks. 20-lb treatment.

Oil Analysis.

| | |
|---|---|
| Specific gravity to 38°C. | 1.133 |

Distillation:

| | |
|---|---|
| Water | none |
| 170°-200°C. | none |
| 200°-210°C. | 1.00% |
| 210°-235°C. | 4.10% |
| 235°-255°C | 9.70% |
| 255°-315°C. | 22.40% |
| Total to 315°C. | 37.20% |
| Specific gravity of fraction 255°-315°C, at 60°C. | 1.04 |

4½ ins. Concrete foundation, Portland cement. ½ in. mortar cushion, 1 part cement to 2½ parts sand. Bituminous-paving joints. ¾ in. expansion joints at curbs. Filler for these joints was a mixture of coal-tar pitch and refined asphalt. Thoroughly air-seasoned lumber steamed at 150°F. for 4 to 4½ hours. Vacuum 24 ins. for 2½ to 3 hours. Temperature not stated. No record of final steaming or vacuum. No expense for maintenance up to Nov. 1, 1916.

**Philadelphia, Pa.** (Chestnut St., 12th St. to 15th St.)—3325 sq. yds. longleaf yellow pine. Average 7 rings; minimum 5. 4 ins. x 8 ins. x 4 in. blocks. 18-lb. treatment.

Oil Analysis.

| | |
|---|---|
| Specific gravity @ 38°C. | 1.1002 |

Distillation:

| | |
|---|---|
| Up to 150°C. | 2.15% |
| " " 315°C. | 31.65% |
| Insoluble in benzol | 2.99% |

6 ins. concrete foundation. 1 in. mortar cushion, 1 part cement to 4 parts sand. Sand-paving joints. 2½ ins. bituminous-expansion joints, 1 in. at each curb and ¼ in. on outside of both rails. Green and partly air-seasoned lumber. Steamed at 225° to 240°F. for 4 hours. Vaccum, 23 ins. for 1½ hours. Temperature not stated. No final steaming or vacuum. No expense for maintenance up to Nov. 1, 1916.

## Paved in 1916.

**East St. Louis, Ill.** (Broadway from 3rd St. to St. Clair County Turn-Pike.)—4700 sq. yds. longleaf yellow pine. Minimum 5 rings, average 7. 3 ins. and 4 ins. x 5 ins. to 8 ins. x 3½ ins. deep blocks. 16-lb. treatment. No oil analysis reported. A product of coal-gas tar, specific gravity 1.07 minimum to 1.11 maximum at 38°C. was specified. 7 ins. concrete foundation, ⅝ in. mortar cushion. Bituminous-paving joints. 1 in. combination asphalt and fiber-expansion joints at curbs. Partly air-seasoned lumber. Some blocks were steamed for 5 hours at 236°F. Vacuum, 24 ins. for 2 hours. Temperature not reported. No final steaming or vacuum. No maintenance expense reported up to Nov. 1, 1916.

**Dayton, Ohio.** (Grand St., from Salem St. to Grafton Ave.)—4200 sq. yds. longleaf yellow pine. 6 rings per inch. 4 ins. x 5 ins. to 10 ins. x 3½ in. blocks. 20-lb. treatment. No oil analysis reported; 1.08 to 1.14 gravity. Tar oil specified, but no analysis given. 6 ins. 1.3.6. concrete foundation. ½ in. 1.4 mortar cushion. Asphalt paving joints, ¾ in. asphalt-expansion joints at curbs. Blocks steamed at 220°F., time not stated. Vacuum, 20 ins. at 170° to 200°F., time not stated. Final steaming temperature and time not stated. No final vacuum. New pavement, no maintenance expense up to Nov. 1, 1916.

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## TAMARACK AND NORWAY PINE.

### Paved in 1913-1914-1915.

**Austin, Minn.** (Kenwood Ave., South Main St., Lansing Ave., Bridge St., Maple St. and Greenwich St.)—60,000 sq. yds. 5 ins. to 10 ins. x 3 in. deep blocks. 16-lb. treatment. Oil analysis not reported. 5 in. concrete foundation. 1 in. sand cushion. Pitch-paving joints. 1¼ in. asphalt-expansion joints at curbs. No record of details of treatment. No maintenance expense up to Nov. 1, 1916.

### Paved in 1913.

**Duluth, Minn.** (1st St., 2nd Ave. East to 6th Ave. East.)—8700 sq. yds. tamarack. 3 rings per inch. 5 ins. to 10 ins. x 3½ in. deep blocks. 16-lb. treatment. Society for Standardizing Paving 1912 specifications for oil which permitted alternatively a coal tar distillate or a coal tar-paving oil. No report as to which type of oil was used. Concrete foundation. ½ in. to 1 in. sand cushion. Bituminous-expansion joints at curbs. Block laid at an angle of 22½° with a line at right angles to the center line of the street. No record of details of treatment available. No report received of maintenance expense.

**Billings, Mont.** (1st Ave. South or District 87.)—29000 sq. yds. western tamarack, texture not stated. 4 ins. x 5 ins. to 10 ins. x 3 in. deep blocks. 16-lb. treatment.

Oil Analysis.

| | |
|---|---|
| Specific gravity at 38°C | 1.115 |
| Insoluble in benzol and chloroform | 2.49 % |

Distillation.

| | |
|---|---|
| Up to 150°C | 0.10 % |
| 150 to 170°C | 0.70 % |
| 170 to 210°C | 4.13 % |
| 210 to 235°C | 6.53 % |
| 235 to 355°C | 43.79 % |
| Residue | 42.56 % |
| Loss | 2.19 % |

5 ins. concrete foundation. 1 in. sand cushion. Bituminous-paving joints. Two-1 in. expansion joints at curbs, 4 ins. total, filled with mixture of equal proportion of asphalt and pitch. Moisture content of untreated wood about 13 lbs. per cubic foot. Blocks steamed and a final vacuum used. Other details of treatment not reported. About $5.00 maintenance expense up to Nov. 1, 1916.

### Paved in 1914.

**Rochester, Minn.** (East 5th St., Broadway to Central St.) 16500 sq. yds. Norway pine and tamarack. 6 rings per inch. 4 ins. x 5 ins. to 10 ins. x 3 in. deep blocks. 16-lb. treatment. Oil used was coal tar product. Analysis not reported. 5 ins. concrete foundation. 1 in. sand cushion. Paving pitch joints. 1 in. paving pitch-expansion joints at curbs. No record of details of treatment available, probably the same oil and treatment as Duluth, Minn., work, as the same manufacturer did both. No maintenance expense up to Nov. 1, 1916.

**Spokane, Wash.,** (Trent Ave., from vacated Grant St. to Division St.)—13,000 sq. yds. tamarack. 11 rings per inch. 4 ins. x 6 ins. and 8 ins. x 3½ ins. deep blocks. 12-lb. treatment. Oil used was reported as creosote with average analysis as follows:

| | |
|---|---|
| Specific gravity at 38°C | 1.105 |

Distillation.

| | |
|---|---|
| Up to 150°C | 0 |
| " " 200°C | 0.4 % |
| " " 210°C | 0.9 % |
| " " 315°C | 37.3 % |
| Insoluble in benzol and chloroform | 1.68 % |

Condition of residue above 355° C. hard and brittle at 77° F.

5 ins. concrete foundation. ¾ in. sand cushion. Coal-tar pitch-paving joints. 2 ins. coal-tar pitch-expansion joints at curbs. Transverse expansion joints every 100 ft. Partly air-seasoned lumber. No preliminary steaming and vacuum. No final steaming. Final vacuum, 15 ins. at 180°F. for 30 minutes. $30.00 expense for maintenance up to Nov. 1, 1916.

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DOUGLAS FIR.

**Paved in 1915.**

**Tacoma, Wash.** (Puyallup Ave., from Pacific Ave. to "A" St.)—1866 sq. yds. Minimum 6 rings. 4 ins. deep blocks. 16-lb. treatment. Oil used was German and English oil. No report of analysis available. 6 ins.—1.3.6. concrete foundation. ½ in. 1:4 damp mortar cushion. Special paving joints, lower half depth asphaltic pitch, upper half 1:3 grout. 1 in. expansion joints of asphaltic pitch, and 20% cement at the curbs. Green lumber. No preliminary steaming or vacuum. Final vacuum, 24 ins. for one hour at 180°F. No maintenance expense up to Nov. 1, 1916.

SHORTLEAF NORTH CAROLINA PINE.

**Paved in 1913.**

**Watertown, N. Y.** (State St., from Pleasant to Colonade St.)—7500 sq. yds. Texture not reported. 3 ins. deep blocks. 18-lb. treatment. Oil analysis not reported. 6 ins. concrete foundation. ½ in. sand cushion. Sand-paving joints. 3 ins. prepared felt-expansion joints along curbs. No details of condition of lumber or treatment reported. This street has required $50.00 maintenance up to Nov. 1, 1916, to take care of bleeding and bulging. Pavement is now in good condition.

More details and further observation are desired on this work as it is the only acknowledged North Carolina pine pavement that the Committee succeeded in locating.

**WOOD-BLOCK PAVEMENTS REPORTED BY DIFFERENT CITIES AS BEING FAILURES OR MOST UNSATISFACTORY.**

**1903-1916.**

**Minneapolis, Minn.** (Third Ave., South from 5th St. to Grant St.)—14682 sq. yds., Norway pine, average run, some coarse and some fine. 4 ins. x 6 ins. to 10 ins. x 4 ins. deep blocks. 12-lb. treatment. No oil analysis. Oil reported under name of Kreodone. 6 ins. concrete foundation. 1 in. sand cushion. Some pitch-paving joints and some cement grout. 1 in. bituminous-expansion joints at curbs. No details of condition of lumber or process of treatment are available. This pavement is failing through decay of blocks as the result of insufficient penetration of the oil into the sap wood. The street will probably be resurfaced eventually with wood blocks of better quality, better oil, and more thorough treatment.

On Nov. 1, 1916, after 13 years of service the condition of this pavement is not so extremely poor as to necessitate resurfacing.

**1905-1916.**

**Duluth, Minn.** (First St., from 2nd Ave., East to 6th Ave., West.)—12,000 sq. yds.

Report of 1915 Committee shows this pavement as Tamarack, but the City Engineer now states that all kinds of wood were used.

The size of blocks is not stated. The 1915 report shows that 3 ins., 3½ ins. and 4 ins. deep blocks have all been used in Duluth. There is no record of the kind of oil used or quantity injected. 6 ins. concrete foundation. 2 ins. sand cushion. Bituminous-paving joints. No details of condition of lumber or process of treatment available.

On Nov. 1, 1916, after 11 years, this pavement showed signs of wear, but is still in service.

**1906-1916.**

**Springfield, Mass.** (Main St., from Bliss St. to William St.)—6460 sq. yds. black gum. 3 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 20-lb. treatment. Oil stated to be creosote; no analysis available. 5 ins. portland cement-concrete base. Dry mortar cushion. Cement grout-paving joints. 1 in. pitch-expansion joints along curbs, and transversely at intervals not stated. Lumber was air-seasoned and not steamed. A preliminary vacuum of 26 ins. at 175° to 200° F. was used. There was no final steaming or vacuum. This pavement is a natural failure, due to excessive wear after 10 years of service. The street will probably be resurfaced with yellow pine. It is reported that most of the wood-black pavements in Springfield show considerable wear and roughness with 10 years' service under traffic conditions existing there. During the past 10 years one side of this street between street-car tracks and

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curbing has been renewed for part of the length. A portion of Main St. pavement adjoining street-car tracks between Liberty St. and Lyman St. laid in 1901, was taken up in 1912 on account of excessive wear and roughness after 11 years of service.

**1906-1913.**

**Sioux City, Iowa.** (Fourth St., from Pearl St. to Iowa St.)—20,000 sq. yds. Norway pine and tamarack. Texture not known. 4 ins. x 8 ins. x 3 ins. deep blocks. 16-lb. treatment. No analysis of oil available. Oil stated to be heavy creosote from distillation of coal tar. 6 ins. foundation of natural cement and limestone aggregate. 1 in. sand cushion. Paving joints thought to be bituminous. ½ in. expansion joints, two in each gutter. The 1913 relaying was on a 1 in. dry mortar cushion with bituminous paving joints. No details of condition of lumber and process of treatment available; specifications were quite general, and it cannot be told now just what was done. In 1913 after 7 years' service this pavement was relaid, using such of the old blocks as were good, and the remainder of new blocks. Street should now (Nov. 1, 1916), be entirely repaved, but it is not expected to use wood block for the resurfacing.

**1907 and 1908-1916.**

**Chicago, Ill.** (Lincoln Ave., from Wrightwood Ave. to Irving Park Boulevard.)—35,240 sq. yds. longleaf yellow pine, minimum 6 rings. 4 ins. x 5 ins. to 10 ins. x 4 ins. deep blocks. 16-lb. treatment. Oil analysis not reported. Oil stated to be Kreodone—creosote-paving oil. 6 ins. portland cement-concrete foundation. 1 in. sand cushion. Bituminous cement-paving joints. 1 in. expansion joints of same material at curbs. ½ in. transverse joints every 100 ft. Lumber was partially seasoned. Blocks were steamed for 1½ hours at 200° to 220° F. 26 ins. vacuum for 1¾ hours at 220° to 145° F. No final steaming or vacuum. This pavement failed on account of moisture or water seeping between brow along street-car rail, and washing cushion from under blocks; also from carelessness in not properly providing for expansion when laying the blocks. About 2036 sq. yds. of this pavement have been relaid up to Nov. 1, 1916.

**1909 and 1910-1916.**

**Albert Lea, Minn.** (Main St. [1909], Clark St. [1910]).—Norway pine and tamarack. 4 ins. x 4 ins. to 9 ins. x 3 ins. deep blocks. 16-lb. treatment. No record of type of oil used. 5 ins. and 6 ins. concrete foundation. 1 in. sand cushion. Bituminous paving joints. 1½ ins. and 1 in. bituminous-expansion joints at curbs. No report of condition of lumber and details of treatment. These pavements have given trouble on account of heaving, due to imperfect treatment of blocks, and poor filler and expansion joints. It is stated that wood-block pavements expand during cold and wet weather and that a pitch filler has no expansion qualities during such period. It is proposed to avoid future trouble of this kind by using an asphaltic joint filler, and having competent inspection. No records of maintenance available.

**1909-1916.**

**Delaware, Ohio.** (Winter St., from Franklin St. to Elizabeth St.)—This is the oldest wood block pavement in Delaware. Longleaf yellow pine, 90% heartwood. 3 ins. x 6 ins. to 8½ ins. x 3 ins. deep blocks. 16-lb. treatment. No record of type of oil used. 6 ins. 1.3.6. concrete foundation. 1 in. sand cushion. Sand-paving joints, except tar for 2 ft. next to curb. 2 ins. tar-expansion joints at curbs. The street is 34 ft. wide between curbs. ½ in. transverse tar joints every 50 ft. No record of condition of lumber and details of treatment. This pavement gives trouble on account of buckling, and at this date (Nov. 1, 1916), some pieces are 3 ins. to 6 ins. high. It is stated that it is doubtful if the blocks received full 16-lb. treatment. It is proposed to avoid future trouble of this kind by using tar-paving joints instead of sand, and inspecting the treatment at the plant. This street does not require resurfacing after 7 years' service, and the cost of maintenance to Nov. 1, 1916, is reported as amounting to $100.00.

**1910-1912 and 1914.**

**Bridgeport, Conn.** (State St., from Main St. to Broad St.)—1700 sq. yds. longleaf yellow pine. Minimum 5 rings, average 8. 3 ins. x 5 ins. to 8 in. x 3½ ins. deep blocks. 16-lb. treatment. No record of type of oil used. 6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ¾ in. pitch-expansion joints at curbs. ½ in. transverse pitch joints every 75 ft. No report of condition of lumber and details of treatment. Trouble in this pavement occurs at crossovers within trolley section. The movement of the track

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produces leaks in the pavement, and frost does the rest. This pavement was taken up at the trolley special work in 2 to 4 years after it was laid. No record of cost of maintenance available. It is proposed to remedy the situation by using improved granite block for the trolley section.

**1911-1916.**

**Spokane, Wash.** (Monroe St. Bridge.)—3,000 sq. yds. fir. 11 rings per inch. 4 ins. x 6 ins. to 8 ins. x 4 ins. deep blocks. Treated with avenarius carbolineum; quantity not stated. Concrete foundation; depth not stated. 1 in. sand cushion. Asphalt-paving joints. 2 ins. asphalt-expansion joints at curbs and transversely 100 ft. apart. Lumber was partly air-seasoned. No steaming or vacuum, either preliminary or final. Trouble is due to bulging attributed to insufficient treatment permitting high absorption of moisture. Bridge will be resurfaced with wood block of 16-lb. treatment, which is expected to correct the difficulty. Maintenance expense has been $500.00 up to Nov. 1, 1916.

**1912-1916.**

**San Angelo, Tex.** (Chadbourne, Beauregard and Concho Sts.)—43,000 sq. yds. yellow pine. 4 ins. x 6 ins. to 8 ins. x 3 ins. deep blocks. Treated with 20 lbs. of oil; type not reported. 5 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ¾ in. asphalt-expansion joints at the curbs. No record of condition of lumber or details of treatment. The trouble with these pavements is excessive shrinkage, owing to long dry seasons, improper creosoting and sand-paving joints. Pavement has cost 10c per sq. yd. for maintenance. It is expected to relay the blocks, using asphalt filler for the paving joints to correct the difficulty.

**1912 and 1913-1916.**

**Charleston, S. C.** (Phillip St., from Calhoun to Vanderhorst St., and King St., from Ann St. to Columbus St.)—2,000 sq. yds. and 7,891 sq. yds. respectively. Mixed southern pine. Texture not specified. 3 ins x 8 ins. x 3 ins. blocks. 16-lb. treatment. Specifications called for coal-tar product free from adulteration. 1.10 to 1.14 gravity at 38°C. Insoluble in benzol and chloroform 3½% maximum. Distillation requirements 2% maximum up to 150°C. 30 to 40% up to 315°. Wood air-dried, mixed loblolly, shortleaf and longleaf pine. Treatment, live steam, average temperature 250° F., held for average of 5½ hours. Average vacuum, 23 ins. mercury; average duration 1¾ hours. Oil treatment, average maximum temperature 205°F.; maximum pressure, 150 lbs.; average duration 2½ hours. No steaming or vacuum after treatment. No oil analysis. 1 in. sand cushion. Sand-paving joints. 1 in. bituminous-expansion joints at each curb. The creosoted wood blocks in these streets have been decayed badly. The contractor has a local representative who makes repairs as defects show up. The cost of this has been considerable, but the exact amount is not known. The pavements are still under guarantee and the city is trying to reach a settlement with the contractor. There has also been trouble from bulging on these streets. The City Engineer says the remedy is to "get better blocks." This failure has been written up with illustrations in the "Engineering News," Feb. 3, 1916, p. 205. Reference to it was also made in a paper by Dr. Hermann von Schrenk, published in the 1915 Proceedings, p. 192, of the American Society of Municipal Improvements.

**1906-1916.**

**Boston, Mass.** (Washington St., from Milk St. to Essex St.)—This street was paved in 1906 with black gum blocks. The trouble with this street has been that the blocks wore off round on the edges and corners, thus leaving the surface rough and cobbled similar to an old-style granite block. This failure is in litigation as the pavement carried a 10-year guarantee, and no details are available at this writing, therefore above report made on outside information.

**1912-1916.**

**Memphis, Tenn.** (Vance St., from Front St. to Fourth St.)—12,833 sq. yds. (including street railway area) southern longleaf yellow pine. Minimum 6 rings. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep block. 16-lb. treatment. Oil analysis not reported. Pure coal-tar product specified. 6 ins. concrete foundation. 1½ ins. sand cushion. Pitch-paving joints. 2 ins., pitch-expansion joints at curbs. Condition of lumber and details of treatment not reported. The trouble with this pavement is that the street-railway tracks pump water through foundation and shift the sand cushion. In some places the blocks now rest on the bare concrete and in other places the sand cushion is 6 ins. thick. Probably $1000 has been spent on this pavement up to Nov. 1, 1916, and it is estimated that $3500 more is necessary to put it in shape. It is pro-

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posed to take up the old blocks and relay them, using about 25% of new blocks. In relaying the pavement, the sand cushion will be removed and the blocks relaid on ½ in. of asphalt on a mortar coating. Practically no repairs of wood block have been needed in Memphis where car tracks do not exist.

**1910-1916.**

**Billings, Mont.** (Minnesota Ave., 26th to 29th Sts.)—10,000 sq. yds. eastern tamarack. 4 ins. x 4 ins. to 9 ins. x 3 ins. deep blocks, 16-lb. treatment. Heavy creosote. No analysis available. 5 ins. concrete foundation 1 in. sand cushion. Pitch-paving joints. Two 1-in. pitch-expansion joints at curbs, total 4 ins. Condition of lumber and details of treatment not reported. The trouble with this pavement is bulging in cold weather when blocks become wet. The treatment of these blocks was not inspected, and proper treatment was therefore not assured. Blocks were laid too close, and the pitch filler hardens in cold weather, thus forcing the blocks to bulge from expansion. $800 maintenance has been put on this street up to Nov. 1, 1916, and it is proposed to apply a carpet coat of thin oil as an experiment to remedy the trouble. Blocks show little wear.

**1913-1916.**

**Paris, Tex.** This city had 5500 sq. yds. of 4 ins. x 8 ins. x 8 ins. longleaf pine blocks laid on the Public Square in 1913. Blocks were laid on 5 ins. of gravel concrete. 1 in. sand cushion and bituminous-paving joints. 1 in. bituminous-expansion joints were placed at the curbs. Paris was swept by fire on March 21, 1916, the greater part of the city being destroyed, and for this reason no detail records of the treatment of these blocks are available. Until shortly before the fire this wood-block pavement had never given any trouble, but was then in such a condition that any hard rain would cause it to bulge and blow up. The fire burned the pavement in places as much as ½ in. deep.

**Brooklyn, N. Y.**—There have been two wood-block failures in this city. One was a pavement laid on a sand base by a land improvement company, and went bad, owing to the fact that there was no concrete under it. The other street that failed was on Broadway. This pavement was replaced by improved granite blocks. The question of the guarantee on the wood block surface is now a matter of litigation, and the details of this failure cannot be reported at this time. This street should be noted for future investigation, and report after the guarantee has been passed by the courts.

**Dallas, Tex.**—The Committee has received a general report that the oldest blocks have begun to decay, and considerable expense is now incurred in taking up single rotten blocks here and there and replacing them with good blocks. It is reported that many of the blocks were insufficiently treated, owing to the fact that heavy refined coal-tar oil was used. As a remedy, the Engineer suggests the use of a creosote distillate oil. This opinion is based upon the fact that one pavement in Dallas, about 5 years old, treated with a pure English creosote distillate oil of about 1.045 gravity, is giving satisfaction.

The Committee has not, as yet, received an official report relative to any of the wood block pavements in the Borough of Manhattan, New York, that have failed, but thinking that the members attending this convention might find it of interest to examine some of the poorer pavements, we give below a list of these streets with unofficial comment as to the probable causes of the defects which have developed in them. All of these streets are under very heavy traffic in the lower part of Manhattan. The amount of repairs is stated for each street.

WOOD-BLOCK PAVEMENTS IN NEW YORK CITY.

**Laid in 1904.**

**Warren St., Broadway to Church St.**—1740 sq.yds., 18% of repairs in 1915. This street has been in a torn-up condition, owing to the installation of service pipes, etc., for several years.

**Laid in 1905.**

**Chambers St., Broadway to West St.**—25% of repairs in 1913 and 1914. This street has been constantly torn up for installation of various pipe-lines, etc.

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**Jay St., Hudson St. to Staple St.**—535 sq. yds., 12% of repairs in 1913 to 1915.

**Reade St., Center St. to West St.**—8802 sq. yds., 52% of repairs in 1913 to 1915. Has been constantly torn up for several years.

**Staple St., Jay St. to Harrison St.**—370 sq. yds., 65% of repairs in 1913 to 1915. Committee not familiar with conditions. Data taken from "Municipal Blue Book."

**Laid in 1906.**

**Battery Place, Broadway to West St.**—8200 sq. yds., 20% of repairs in 1915. This pavement is defective from the manner in which it was laid. It has shifted badly on the sand cushion.

**Dey St., Greenwich St. to West St.**—3371 sq. yds., 14% of repairs in 1915. Has been in a constantly torn-up condition for several years for the installation of pipe-lines, etc.

**Greenwich St., Battery Place to Dey St.**—9681 sq. yds., 16% of repairs in 1913 and 1914. Has been torn up a great deal for the installation of pipe-lines, etc.

**Greenwich St., Vesey St. to Chambers St.**—4571 sq. yds. Had 31% of repairs in 1915. Has been constantly torn up for the installation of service-pipes, etc., for several years.

**Vesey St., Broadway to West St.**—4934 sq. yds. Had 13% of repairs in 1913 to 1915. Has been constantly torn up for several years for the purpose of installing pipe lines, etc.

**Laid in 1909.**

**State St., Whitehall St. to Bowling Green.**—6533 sq. yds. Had 51% of repairs in 1913 to 1915. Pavement originally laid with a mixture of black gum and red gum blocks. Red gum blocks did not take treatment.

One of the foregoing cities claims that the wood-block pavement has not been satisfactory, because at the time of a destructive fire in the city this pavement was burned and a great deal of the oil appeared to have been cooked out of the blocks. While these blocks were in excellent shape before the fire they afterward became little better that untreated blocks, absorbing water after every rain and buckling badly.

We hardly feel that this can be considered a defect in the wood-block pavement, for we have several cases on record where wood-block pavements have passed through very destructive fires and were little injured, as for instance, in Philadelphia, Pa., two piers, Nos. 34 and 35, were paved with wood-block in 1910. The blocks were long leaf yellow pine 3 inches x 8 inches x 3 inches, 16-pound treatment water-gas tar on concrete foundation. Blocks were given preliminary steaming and vacuum, but no final steaming or vacuum was used. In 1914 Pier No. 35 was burned, which subjected these blocks to a severe fire test. The heat was so great that the structural steel-work was fused and the greater portion of the fused and burning material fell upon the wood-block floor. After the removal of the debris it was found that the wood-blocks were charred ⅛ in to ¼ in. in depth under direct flames, and ¾ in. to 1 in. where touched by the fused steel. In reconstructing the pier the flame-charred blocks were scraped and allowed to remain in service, while the blocks more deeply charred by the hot steel were turned over and relaid. This burned floor has

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cost no more for upkeep since that time than the wood-block floor on the adjoining Pier No. 34.

In Baltimore, Md., several wood-block pavements went through the great conflagration of 1904 in that city without any material damage, and many of them are giving good service today, 12 years after the fire.

The Committee wishes to apologize for the hastily drawn up report which has been presented this year, but it has been impossible in the short time at its disposal to do much more than give the bare facts reported by the various city officials.

We recommend that future committees on service tests of wood-block pavements endeavor to fill out the missing information on the streets herein reported, and to keep a record from year to year of the behavior of these streets; especially examine more closely into the streets which have failed and endeavor to find out what has been the actual cause of these failures. We would advise that these examinations, where possible, be made by members of the Committee in person, so that an accurate report can be made on them and a means devised to prevent their recurrence in future paving work. We also advise that the Committee endeavor to get full reports from the cities that have not replied. This might be done in many cases by members of the Committee visiting the cities in person.

As we have had but a few reports on Norway pine, tamarack and black gum, we would advise that future Committees obtain the names of more streets paved with these woods for the purpose of studying their action under different kinds of traffic and conditions.

In the case of failures in pavements, we most strongly advise that future committees obtain traffic census of the street as well as records of cuts, etc., that might be factors in the life of the pavement.

The present Committee has been unable to collect any data on wood-block paving of bridges and factory floors. This should also be looked into by future committees, and a study made of the best treatment and kind of oil to meet these conditions.

A. W. Dow,
J. C. WILLIAMS,
ERNEST G. DRAPER.

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MR. M. K. TRUMBULL: Does the report contain recommendations?

THE PRESIDENT: You will see those right there at the last.

MR. M. K. TRUMBULL: Nothing in the way of conclusions or results of this test?

THE PRESIDENT: No. Gentlemen, what do you want to do with this report?

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MR. WALTER BUEHLER: I want to clear up the reasons for two of the failures mentioned. One is at Duluth, Minn., and the other is Sioux City, Ia. In Duluth, Minn., a 4-in. block was used. The contractor in putting in his concrete failed to provide the space for the cushion. He had just 4 ins. from the pavement to the top of the manhole covers, and 4 ins. to the top of the catch-basins. The matter was taken up with the City Council at the time. We tried to get them to cut down the size of the blocks. They would not do that. We wanted them to cut out the manholes and raise the grade of the street, and they would not do that. They finally worked out the proposition of starting from the center of the street with no sand cushions and feathering it out to the curb to about 1 inch. This no doubt will account for the failure. Part of the blocks were laid directly on a rough concrete, and part of them on a sand cushion. The street was rough right from the very beginning. Sioux City, Ia., re-surfaced an asphalt street. The concrete was very rough, and therefore the sand cushion would vary anywhere from ½ in. to 2 ins., which I believe will account for the failure. I believe it important to get at the real reason for the failure whenever possible.

THE PRESIDENT: Are there any further comments? Any information that you may have regarding the streets that have been mentioned here?

MR. A. W. DOW: I would like to say, as a member of the Committee, that this report should be considered as the beginning of service tests on wood blocks, and it would be of great advantage to the members of the Committee, and of course to the Association, if the individual members of the Association would look up failures or look up the good pavements and make personal reports on them. We would then feel that the source of information was in men who knew something about the business, rather than taking the report and conclusions of a city engineer who may be prejudiced. I think it would be conferring a great favor upon the Association if individual members will pick out pavements in their own locality and in their leisure time make reports to the Committee on either the failure or the success of the pavements.

MR. F. J. ANGIER: Mr. President, I would like to ask the Committee who there is in Baltimore that knows anything about this paving that went through the 1904 fire and is serviceable today. I took the trouble to look into that a little and no city official there that I can find knows anything about it.

MR. A. W. DOW: I may be responsible for that. I have been inspecting for Baltimore for the last 10 or 12 years all classes of paving material, and Mr. Fiedler, the old City Engineer, told me of that. I

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was also present in Baltimore directly after the fire and saw some of the pavements.

MR. F. J. ANGIER: Did you see this pavement lately?

MR. A. W. DOW: They took the pavement up and turned the blocks over.

MR. F. J. ANGIER: Do you know what street it was on?

MR. A. W. DOW: I could not tell you now, but I can find out for you.

MR. F. J. ANGIER: I would like to look at it.

MR. J. C. WILLIAMS: It is pretty well authenticated. The people who laid the blocks got quite an advertisement out on it at the time of the fire.

THE PRESIDENT: Are there any further remarks?

MR. J. C. WILLIAMS: Mr. President, I move the acceptance of the report as information. That is all that it is compiled for, and I would urge the carrying out of the recommendations, especially regarding those best streets. They cover quite a range of construction and oil and depth of blocks, and if they are conscientiously followed up at intervals of two or three years, it will only be a short time, comparatively speaking, before we will have some definite information as to what constitutes a good wood-block pavement.

MR. M. K. TRUMBULL: I will second that motion, providing Mr. Williams will be willing to add to it that we instruct the Committee for the coming year to summarize the detailed results, which are secured, and if possible to submit conclusions.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

I would just like to say that due to a misunderstanding this Committee did not get to work until very late in the year. It had only a very few weeks to prepare this report, and I think the Association should understand that feature. I believe you will agree with me that it is a most excellent report, considering the time the Committee has had.

We will now have the report of the Committee on Wood-Block Paving. The members of this Committee are: Mr. C. H. Teesdale, Chairman, Mr. Walter Buehler, Mr. F. W. Cherrington, Mr. F. P. Hamilton, Mr. H. S. Loud, Mr. H. M. Newton. Will the members of the Committee kindly take their places on the rostrum?

MR. C. H. TEESDALE: Mr. Chairman and Members of the American Wood-Preservers' Association: Before I take up this report

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I wish to report two or three changes that the Committee has made in the specification. In the pamphlet report, page 5, Section 4, second paragraph, eliminate the words "either preceded or," and on page 8, under "Filler," Section B, change 22½ to 18%. Section B will then read:

Free carbon shall not be less than 18% nor more than 37%.

The method of analysis for free carbon will be changed to conform with the report of the Committee on Preservatives. In the pamphlet report on page 9, Specifications for Treating Douglas Fir Paving Blocks, eliminate all of the last sentence.

(These changes have been made in the report as published on pages 451-461.)

## REPORT OF THE COMMITTEE ON WOOD-BLOCK PAVING.

*To the Members of the American Wood-Preservers' Association:*

The instructions of the Executive Committee to the Committee on Wood-Block Paving for 1916 were as follows:

1. Collect and compile all specifications and definitions concerning wood-block paving which have been approved by the Association. Recommend such revisions as may be necessary and present for insertion in the Manual.

2. Prepare a specification for the treatment and laying of creosoted wood blocks. This does not include specifications for the preservative. The Executive Committee desires that, aside from making it clear that a firm foundation is necessary for satisfactory service from a wood-block pavement, the Committee confine its specifications to the superstructure of a roadway or floor. This includes the surfacing of the sub-structure, the cushion, the blocks, and the filler between them. The composition of the sub-structure is not within the province of the American Wood-Preservers' Association.

3. Present recommendations for future work to be undertaken by your Committee.

The Committee has been unable to find a record of the Association having approved any specification or definitions concerning wood-block paving.

During the past year a meeting was called at Brooklyn, N. Y., which the members of six associations interested in wood-block paving were invited to attend. This meeting was presided over by George W. Tillson. Representatives of the following associations were present: American Wood-Preservers' Association, American Society of Municipal Improvements, American Society for Testing Materials, American Society of Civil Engineers, American Railway Engineering Association, and the Southern Pine Association. The object of the meeting was to endeavor, if possible, to have the committees who were working on wood-block paving specifications present identical specifications to their

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respective associations. The meeting was successful in this respect, and the members of the various committees agreed to present identical specifications on timber, size of blocks, treatment, handling after treatment, and inspection. The remaining items (cushion, foundation, laying, filler) were not considered by the joint meeting.

Your Committee very strongly recommends that the Association adopt the specifications recommended by this joint meeting without material change. The Committee feels that it will be a big step in advance if uniform specifications are adopted by the different associations interested.

The specification which we are recommending this year is substantially the same as was submitted last year as information. Only minor changes have been made, the most important of which concerns the method of applying the oil under pressure.

Your Committee differed from the opinion of the joint meeting concerning the method of computing absorption of preservative, but has felt that for uniformity we should not insist upon including this in the standard specifications. In our opinion this should read as follows: (page 456, paragraph 4, line 5):

> In any given contract the blocks shall contain an average of not less than 16 lbs. of water-free oil per cubic foot of wood at the completion of the treatment. Not less than 15 nor more than 17 lbs. per cubic foot will be permitted in a given charge.

In order to obtain at least 16 lbs. per cubic foot in any charge one should bear in mind that the average absorption of several runs will usually be between 16.4 and 16.7 lbs. per cubic foot.

In addition to the specifications offered last year, one on pitch filler has been added. In this specification it was the aim of the Committee to obtain a material having a melting point of about 145° F. The lower melting point recommended for fillers on small jobs, or where small kettles are used, was intended to allow for unavoidable evaporation, and should give a filler having approximately 145° F. melting point at the time of use. The Committee believes that either coal-tar or asphalt fillers may be used. Through lack of available information, however, we have been unable to submit a satisfactory specification for asphalt fillers.

The Committee does not approve of the use of sand filler or sand cushion. Successful pavements are in existence where these forms of construction were used. However, there have been so many failures and cases of trouble directly caused either by sand filler or sand cushion that we feel the risk of using them is not offset by their lower cost.

Sand fillers are not waterproof and, hence, permit water to reach the base of the blocks. This often causes trouble from expansion. If the blocks dry out and shrink, the sand settles down in the spaces

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between the blocks, creating the possibility of further trouble if they later become wet and expand.

Sand cushion often causes trouble, especially where there is vibration, by shifting and creating an uneven surface.

It was not feasible for the Committee to prepare a specification for crown that would fit all conditions. The following may be used satisfactorily for streets paved with wood block on which there are no street-car tracks, and which are between 20 ft. and 50 ft. in width.

Height of crown in feet shall be 0.013 of the paved width in feet. This formula gives too much crown for streets wider than 50 ft., or those on which there are street-car tracks. It does not give enough crown on streets less than 20 ft. wide.

It is the opinion of the Committee that if these specifications are carefully followed the resulting street will not bleed excessively, nor should there be serious expansion troubles. The method of forcing in the oil should give the maximum penetration obtainable with the absorption used. These specifications require from 25 to 50% more time than is commonly required for creosoted blocks, but we feel that the possibility of increasing durability and lessening expansion and bleeding troubles warrants this course. City engineers and others who have occasion to use these specifications should bear in mind this item of time, and be sure that it is spent upon treatment. From 10 to 12 hours are required to properly treat southern pine blocks by these specifications.

Your Committee has been impressed with the sentiment gradually crystallizing among engineers and manufacturers in favor of an absolutely rigid and water-tight type of pavement construction. Much favorable attention has been directed to a practice which is, unfortunately, not so common in this country as abroad; namely, that of laying the blocks on a smoothly finished concrete base, and particularly to that form wherein the blocks were either dipped in pitch immediately before laying, or where set in hot pitch swabbed upon the concrete base. Recent examination of some old pavements so constructed has furnished the most convincing argument in favor of such a type. It seems that where this type of construction has been abandoned it has been done solely on account of the fact that it was thought possible to reduce the cost of construction without detrimental effect. In fact, the increased cost seems to be the chief obstacle to its more general adoption.

Within the last two years a new method has been introduced which your Committee believes to be of great importance to the future of this industry. It consists simply in coating the smoothly finished concrete base with bituminous cement, and allowing this to get cold and harden before attempting to set the blocks on it. The expedient

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of allowing the cement first to cool and harden before setting the blocks substantially removes the objection of high cost, and it also removes the objection in regard to difficulty of replacing faulty blocks where set in hot pitch. Furthermore, it accomplishes the same results as if the blocks had actually been set while the pitch was still hot, as it will be found that after a day or so the blocks all adhere firmly to the base.

A series of comparative tests are now in progress to determine safe loads on typical pavement sections made with and without cushion. While incomplete, these tests appear largely to favor the rigid type of construction. They also seem to indicate the feasibility of using a shallower wood block in connection with a smooth base without in any way sacrificing strength.

Your Committee is not prepared to offer a definite specification for this type as a standard, but would earnestly recommend the matter to the attention of the individual members of the Association who are interested in this field, and to the serious consideration of next year's Committee.

### Recommendations for Future Work.

Your Committee recommends that the following work be undertaken by the Committee on Wood-Block Paving for the coming year:

1. Recommend specifications for laying wood blocks in street-railway tracks.

2. Determine whether western larch should be included in the specification as a wood suitable for wood-block paving, and if favorably reported upon recommend a specification for treatment if possible.

3. Recommend specifications for treating Douglas fir-paving blocks.

4. Recommend specifications for asphalt filler.

5. Investigate laying blocks on a bituminous paint coat, and if favorable recommend a specification for this type of construction.

## SPECIFICATION FOR CREOSOTED WOOD-BLOCK PAVING.*

### Timber.

1. KIND: *The wood from which the blocks are to be manufactured shall be southern yellow pine, Douglas fir, tamarack, Norway pine, hemlock, or black gum. Only one kind of wood shall be used in any one contract. The blocks must be sound and must be well manufactured, square butted, square edged, free from unsound, loose or hollow knots, knot holes, worm holes, and other defects such as shakes, checks, etc., that would be detrimental to the blocks.*

*This specification is intended for street work exposed to the weather. It is not intended to be used for flooring or inside work where the blocks are not exposed to the weather.

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*In southern yellow pine or Douglas fir the number of annual rings in the 1 in. which begins 2 ins. from the pith of the block shall not be less than six, measured radially, provided, however, that blocks containing between five and six rings in this inch shall be accepted if they contain 33⅓% or more of summerwood. In case the block does not contain the pith, the 1 in. to be used shall begin 1 in. away from the ring which is nearest to the heart of the block. The blocks in each charge shall contain an average of at least 70% of heartwood. No one block shall be accepted that contains less than 50% of heartwood.*

**Size of Blocks.**

*2. The blocks shall be from 5 to 10 ins. long, but should preferably average two times the depth; they shall be*† *. . . . inches in depth. They shall be from 3 to 4 ins. in width, but in any one city block all of them shall be of uniform width. A variation of 1/16 in. shall be allowed the depth and ⅛ in. in the width of the blocks from that specified. In all cases the width shall be greater or less than the depth by at least ¼ in.*

**Preservatives.**

*3. (Specified by Committee on Preservatives).*

**Treatment.**

*4. The timber may be either air-seasoned or green, but should preferably be treated within three months from the time it is sawed. Green timber and seasoned timber shall not, however, be treated together in the same charge. The blocks shall be treated in an air-tight cylinder with the preservative hereinbefore specified. In all cases, whether thoroughly air-seasoned or green, they shall first be subjected to live steam at a temperature between 220° and 240° F.* for not less than two hours, nor more than four hours, at the discretion of the treating-plant operator, after which they shall be subjected to a vacuum of not less than 22 ins., held for at least 1 hour. While the vacuum is still on, the preservative oil, heated to a temperature of between 180° and 220° F., shall be run in until the cylinder is completely filled, care being taken that no air is admitted. Pressure shall then be gradually applied not to exceed 50 lbs. at the end of the first hour nor 100 lbs. at the end of the second hour, and then maintained at not less than 100 lbs. nor more than 150 lbs. until the wood has absorbed the required amount of oil.*‡

†The Committee recommends blocks 4 ins. in depth for very heavy traffic streets; blocks 3½ ins. in depth for moderate traffic streets. For light traffic streets blocks 3 ins. in depth may be used, but where 3 in. blocks are used no block shall be longer than 8 inches.

*In no case shall a steam pressure of 20 lbs. per square inch be exceeded.

‡This treatment is recommended for yellow pine only. It is probably also suited to Norway pine, hemlock, black gum and tamarack, but not to Douglas fir. Further recommendations on the treatment of these species are reserved for the future.

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*After this a supplemental vacuum shall be applied in which the maximum intensity reached shall be at least 20 ins., and shall continue for a total period of not less than 30 minutes. If desired this vacuum may be followed by a short steaming period.*

*In any charge, the blocks shall contain at least 16 lbs. of water-free oil per cubic foot of wood at the completion of the treatment. The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the oil must be diffused throughout the sapwood. To determine this at least 25 blocks shall be selected from various parts of each charge, and sawn in half at right angles to the fibers through the center, and if more than one of these blocks show untreated sapwood the charge shall be re-treated. After re-treating, the charge shall be again subjected to a similar inspection.*

*The surface of the blocks after treatment shall be free from deposits of objectionable substances, and all blocks that have been materially warped, checked or otherwise injured in the process of treating shall be rejected.*

**Handling Blocks After Treatment.**

*5. The blocks shall preferably be laid in the street as soon as possible after being treated. If they cannot be laid immediately provision shall be made to prevent them from drying out by stacking in close piles and covering them, and, if possible, by sprinkling them thoroughly at intervals. In any case, where they are not laid as soon as they are received on the street they shall be well sprinkled about two days before being laid under the direction of the purchaser. It is important to have the wood sufficiently wet to be swelled to its maximum size before it is laid.*

**Inspection.**

*6. All material herein specified and processes used in the manufacture of the blocks therefrom shall be subject to inspection, acceptance, or rejection at the plant of the manufacturer, which shall be equipped with all the necessary gauges, appliances, and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled.*

*The purchaser shall have the further right to inspect the blocks after delivery upon the street for the purpose of rejecting any blocks that do not meet these specifications, except that the plant inspection shall be final with respect to the kind of wood, rings per inch, oil, and treatment.*

**Foundation.**

*7. The foundation for the pavement shall be of concrete, made in accordance with the specifications of the purchaser for concrete-pave-*

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*ment foundation. At no place shall the surface of the finished concrete vary more than ½ in. from the given grade.*

**Mortar Cushion.**

*8. Upon the concrete foundation shall be spread a layer of thoroughly mixed mortar made of one part of Portland cement of the character provided for in the foundation, and four parts of sand. Only sufficient water shall be added to this mixture to insure a proper setting of the cement, the intention being to produce a granular mixture which may be raked to the desired grade. The mortar shall be spread in place on the foundation immediately in advance of the laying of the blocks. The mortar bed shall be raked to the approximate grade and struck by templates to a surface parallel to the grade and contour of the finished pavement. The finished mortar bed shall have an average thickness of not over ¾ in., and shall in no case be over 1 in. in thickness.*

**Laying the Blocks.**

*9. Upon the bed thus prepared the blocks shall be carefully set with the fiber of the wood vertical in straight parallel courses, leaving a space next to the curb 1 in. in width for the expansion joint.*

*The blocks shall be laid by setting them hand-tight on the base or cushion. No joint shall be more than 3/16 in. in width. They may be driven together every ten courses to keep the rows straight. Nothing but whole blocks shall be used, except in starting a course, or in such other cases as the purchaser may direct; and in no case shall the lap joint be less than 2 ins. Closures shall be carefully cut and trimmed by experienced men.*

*The angle of course to the curb shall be fixed at the discretion of the purchaser.*

*After the blocks are placed on the mortar bed they shall be rolled parallel and diagonally to the curb by a tandem roller weighing between 4 and 7 tons until the surface becomes smooth and is brought truly to the grade and contour of the finished pavement. The rolling shall be completed before the mortar bed has set. All mortar that has set before the blocks are in place and rolled shall be discarded and replaced by fresh mortar.*

*After the rolling is completed the joints between the blocks shall be filled with a bituminous filler. This shall preferably be done only when the temperature of the air is above 45° F. The filler shall be brought to the proper temperature and poured into the joints; and filler on the surface of the pavement must be spread as thinly as possible by means of squeegees. The filler shall be thoroughly worked into the joints between the blocks while hot, leaving no surplus on the pavement.*

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*The surface shall then be completely covered to a depth of about ½ in. with clean, coarse, dry sand, which shall be left upon the pavement.*

OPEN-JOINT CONSTRUCTION.—*When the blocks are laid on streets having grades of 3% or over, it is desirable that the blocks be spaced by laying creosoted wood lath about 5/16 in. thick between each course. The space above the lath shall then be filled with heated crushed stone (containing no dust) and bituminous filler. The joints shall be poured about one-half full with the bituminous filler specified, care being taken to get none on the surface of the pavement. The crushed stone* shall then be swept into the joint, and the space around the stone filled with the bituminous filler to the top of the joint. It is essential, in open-joint pavement, to drive the blocks together every four rows to prevent tipping of the individual blocks.*

**Filler.**

*10. Either coal-tar-pitch or asphalt fillers may be used. The following specifications shall be used for coal-tar-pitch fillers:*

*The pitch used as filler shall be obtained entirely from the distillation of coal-tar, and shall comply with the following requirements:*

A. *Specific gravity at 77° F. (25° C.) shall not be less than 1.22 nor more than 1.34.*

B. *Free carbon shall not be less than 18% nor more than 37%.*

C. *Melting point shall not be less than 140° F. (60° C.) nor higher than 150° F. (65.5° C.) when determined by the half-inch cube method.†*

D. *When 100 grams of pitch are distilled to 670° F. (355° C.) in an 8-oz. retort, specific gravity of the distillate shall not be less than 1.07 at 100° F. (37.7° C.)*

SPECIFIC GRAVITY.—*Ten grams of pitch weighed in a Hubbard type specific gravity bottle whose water capacity at 77° F. (25 C.) has been determined. The pitch is introduced into the bottle in a liquid condition and weight taken after cooling. Freshly boiled water is added, and the temperature maintained at 77° F., water adjusted to mark, and bottle removed from bath and weighed. Weight of pitch divided by weight of water displaced equals specific gravity.*

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*It is very important to have the crushed stone heated, so that the filler will penetrate around them and make a solidly filled joint. If possible the stone should be heated to 350° F. before being applied. This may be done in the sand drum of an asphalt plant.

†On small jobs it is sometimes desirable to use pitch having a melting point from 135° to 145° F., because of the small kettles usually used, which are liable to raise the melting point considerably while the pitch is being heated.

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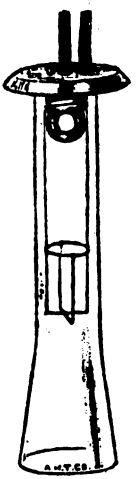
**Insoluble in Benzol.**

APPARATUS.—(A) *Extractor may be of the form shown below, or any similar form in which the pitch is subjected to direct washing by the boiling vapors of the solvent.*



(B) *Filtering medium may be either two thicknesses of S. & S. No. 575 or Whatman No. 5 hardened filter paper, 15 c.m. in diameter arranged in cup-shape by folding symmetrically; or alundum thimbles, flat bottom, 30x80 RA 98. If filter papers are used, prior to using they shall be soaked in benzol to remove grease, dried in a steam oven and kept in a desiccator until ready to be used. The filter-paper cup may be suspended in the extractor flask by a wire basket hung from two small hooks on the under surface of the metal cover of the flask.*

*If the alundum thimble is used, it may be supported by making two perforations in the top of the thimble, and suspending from the cover by German silver or platinum wires.*

METHOD.—*Weigh about 5 grams of pitch in a 100 c.c. beaker, add about 50 c.c. of pure toluol or pure benzol, (preferably the former) and digest on steam bath. Time of digestion should not exceed 30 minutes. Decant solution through the weighed filter cup, prepared as previously described, washing out beaker with hot toluol or benzol until clean, passing all washings through the filter. Then place the filter in the extraction apparatus.*

*Extractor shall contain a suitable quantity of pure benzol. Sufficient heat to boil the solvent shall be provided by means of an electric heater or a steam bath.*

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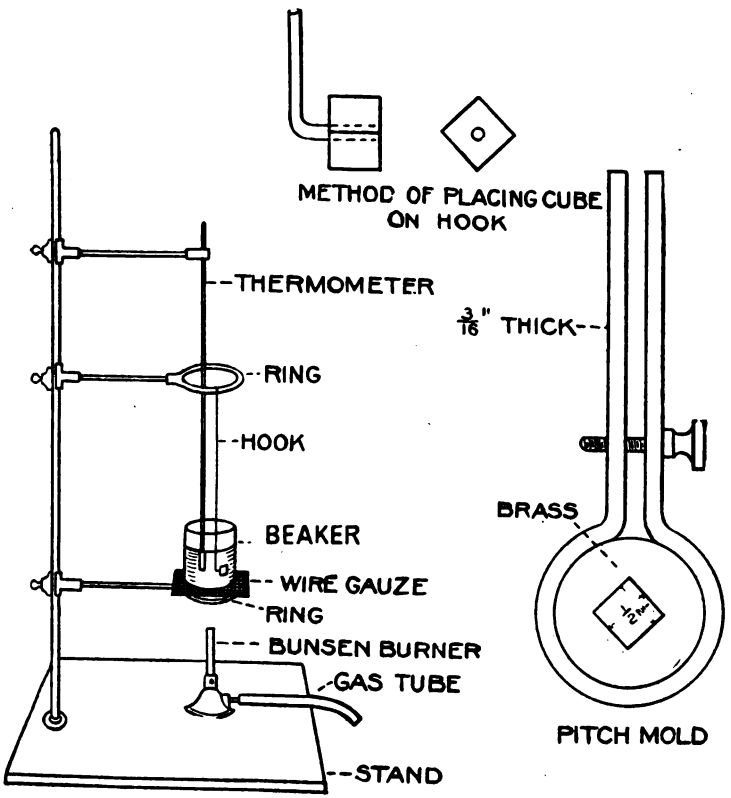
*Continue the extraction until the descending solvent is practically colorless, and remove the filter cup and dry in steam oven until all solvent is driven off; cool in desiccator and weigh. The balance used for this purpose should be accurate to within 0.5 m.g.*

MELTING POINT.—*A clean shaped ½ in. cube of the pitch to be formed in a mold, placed on a hook of No. 12 copper wire and suspended in a 600 c.c. beaker so that the bottom of the pitch is 1 in. above the bottom of the beaker. (A sheet of paper placed on the bottom of the beaker and conveniently weighted will prevent pitch from sticking to the beaker when it drops off.) The pitch to remain 5 minutes in 400 c.c. of water at a temperature of 60° F. (15.5° C.) before heat is applied. Heat to be applied in such manner that the temperature of the water is raised 9° F. (5° C.) each minute. The temperature recorded by the*




Arrangement of Apparatus for Testing for Melting Point of Pitch.

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*thermometer at the instant the pitch touches bottom of beaker to be considered the melting point.*

THERMOMETERS IN KETTLES.—*The kettles in which the filler is heated on the street shall be equipped with approved thermometers, and the pitch shall be heated to a temperature of not less than 250° F., nor more than 300° F., and shall be poured when at a temperature between these limits.*

NOTE.—Engineers should not use this specification as a whole, but should make a selection of material and method where more than one is indicated under the different headings.

## SPECIFICATION FOR TREATING DOUGLAS FIR-PAVING BLOCKS.

(Presented as information.)

Douglas fir should not be handled in the same way as southern yellow pine. It has been found that steaming this wood is undesirable. The following specification is the one recommended by the West Coast Lumbermen's Association, and covers treatment only.

The material shall be treated green, effecting sufficient seasoning by boiling in the oil to admit of complete penetration by the preservative. Blocks shall be treated by the boiling process with 16 to 18 lbs. of coal-tar creosote per cubic foot of wood, which amount shall afterwards be reduced by expansion and vacuum to 10 to 12 lbs. per cubic foot.

The blocks shall be placed in the treating cylinder and the preservative introduced and heated to approximately 215° F. for 2 to 4 hours. The preservative shall then be drained off and a vacuum of 23 to 26 ins.* drawn to take out the surplus oil, vapors, gases, etc., from the wood cells. The vacuum shall then be broken by the introduction again of the preservative, which is then pressed into the wood at a temperature of 180° F. until the blocks have received from 16 to 18 lbs. per cubic foot. After the blocks have received the required amount of oil, the pressure shall be released, and the temperature of the oil gradually raised to 215° to 230° F., and held for 1 hour. This final heating expands the oil, vapors, and gases within the wood, and causes a certain amount of the preservative to be expelled, due to this expansion, and also effects further seasoning of the wood. A final vacuum of 23 to 26 ins. shall then be drawn.

C. H. TEESDALE, *Chairman,*
W. BUEHLER.
F. W. CHERRINGTON,
E. P. HAMILTON,
H. S. LOUD,
H. M. NEWTON,

*The preliminary vacuum in the above treatment may ordinarily be omitted. It is intended for an additional precaution against bleeding of the blocks where it is especially necessary to eliminate this objection.

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## APPENDIX TO REPORT OF COMMITTEE ON WOOD-BLOCK PAVING.

### The influence of the proposed treatment on the strength of paving blocks and the influence which the condition of the timber at time of test may have on strength test data.

**By Clyde H. Teesdale,**

*In Charge, Section of Wood Preservation.*

**and**

**John A. Newlin,**

*In Charge, Section of Timber Tests,*
*Forest Products Laboratory, Madison, Wis.*

Recently there has been considerable discussion on the strength of southern yellow pine blocks when treated in accordance with the methods required by the specification of the Committee on Wood-Block Paving. It has been contended that this treatment seriously weakens the blocks and hence it was felt desirable to conduct tests in which the strength of the blocks could be compared before and after treatment.

The timber for these experiments was obtained in two shipments, the first by purchase from the Kettle River Company, and the second being donated by the Chicago Creosoting Company. The first shipment was received in July, 1916, and stored under cover at the Laboratory, and at the time these experiments were made was in an air-dry condition. The second shipment was received just before the experiments were started and was green. Each of these shipments was divided into two portions, one of which contained blocks with from 50% to 65% of sapwood—considered as sap blocks—and the other containing from 5% to 15% of sapwood—considered as heart blocks.

Five sticks from each of the above groups of wood were selected and cut into paving blocks. Four blocks from each stick were selected for subsequent strength tests, two of them being used for treatment and the other two for controls. The control blocks and the treated ones were cut alternately from the end of the stick.

The preservative used in these experiments was furnished by The Barrett Company, and consisted of a tar and creosote paving oil which would pass the specification presented this year by the Committee on Preservatives.

The treatments were made in the 1½ ft. by 4 ft. cylinder at the Forest Products Laboratory. Two runs were made, the air dry and green blocks being treated separately. A total of 48 blocks were included in each treatment, additional blocks from each of the groups described above being included to provide blocks for further strength tests than those planned for in case this was found advisable.

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A summary of the tests shows that the treated green heart pieces gave average results 3.5% below the corresponding natural pieces, the treated green sap pieces about 1% higher than the corresponding natural pieces, the treated air-dry heart pieces 10% higher than the natural pieces, and treated air-dry sap pieces gave values 8.5% higher than the natural pieces.

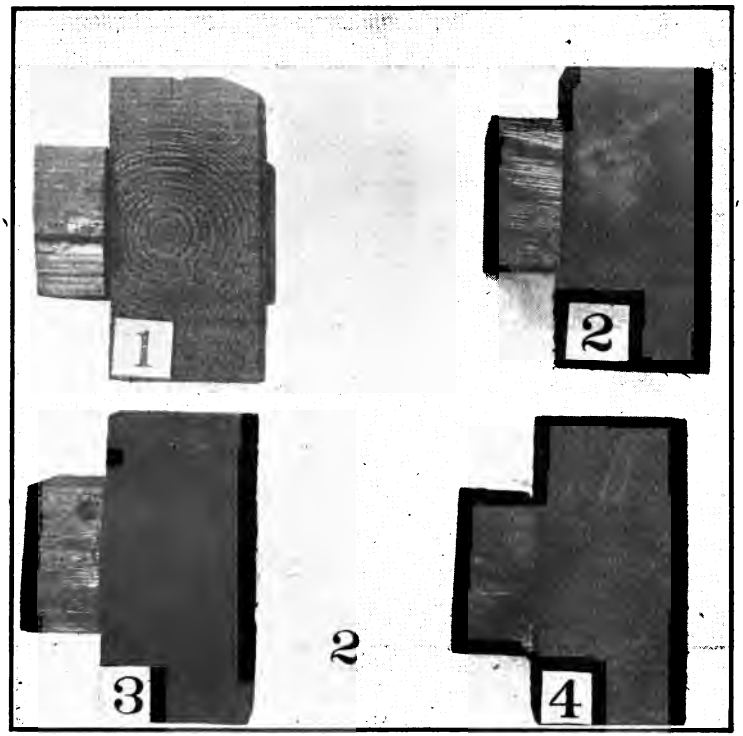


PLATE II.—Penetration of Creosote in Tested Paving Blocks.

1 C—1
2 D—3
3 O—3
4 P—3
} Green Sap.

In our judgment the above tests show no permanent differences in strength due to treatment, the differences being due to the changes in the internal stresses. In the air-dry material it is probable that casehardening introduced in drying was relieved, while in the green material drying stresses were introduced. If placed in service the blocks would normally absorb some moisture. Hence these stresses would probably all disappear and the blocks become of uniform strength.

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**Variations in Test Data Due to Condition of Timber at Time of Test.**

Much confusion will often arise by trying to compare data taken under different conditions. In order to emphasize the need of care in making such comparisons, and to show the extent to which strength values are dependant on different conditions of timber at time of test we have made a few simple experiments to illustrate these points.

The conditions, exclusive of quality or defects, which very materially influence the strength values obtained in tests, are differences in

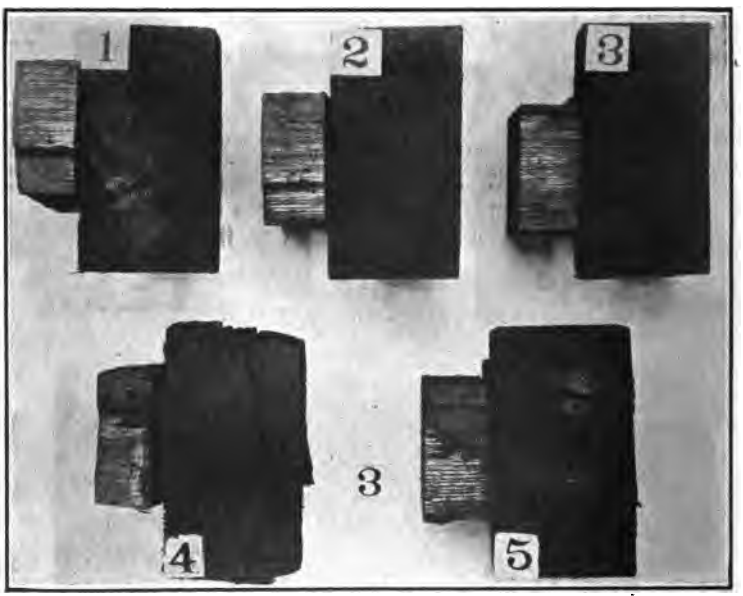


PLATE III.—Penetration of Creosote in Tested Paving Blocks.

1 H—1
2 I—3
3 J—3 } Air-Dry Heart.
4 K—1
5 L—3

moisture content, changes in temperature, and internal stresses caused by shrinkage or other factors. These various factors singularly may very materially influence the test values without any permanent change in the properties of the timber. The combined extreme effect may give an individual piece at least six times the strength in one condition that it has in another.

In one experiment two green paving blocks were placed in the oven and heated to 100° C. for about 5 hours. They were then cut in two, and one-half of each block was steamed for 30 minutes at 0

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pressure. These steamed pieces were then returned to the oven and dried to the same weight that they had previous to steaming. The four pieces were then placed side by side and allowed to stand until the next day, when they were tested. Both steamed pieces gave higher stresses than the unsteamed (5.5% and 13%). This was probably due to the relieving of stresses formed in them by rapid drying.

Some other experiments were run in which three green planks were cut into paving-block sizes. A few of the blocks were tested at once, being brought in directly from the outside. The others were placed in hot water, which was brought to about 95° C. for the last 2 hours. Four of the blocks, two from one plank and one from each of the others, were taken out of the water and tested immediately. The remaining blocks were taken out of the water and put in an oven maintained at about 80° C. For the next 3½ hours two blocks from

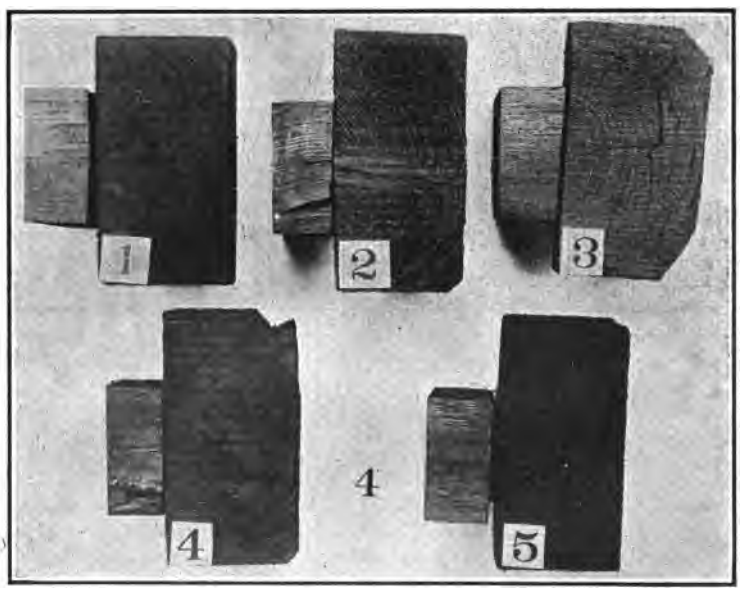


PLATE IV.—Penetration of Creosote in Tested Paving Blocks.

1 E—1
2 F—3
3 G—1 } Air-Dry Sap.
4 M—1
5 N—3

one plank and one from each of the others were tested at half-hour intervals; this exhausted the supply of blocks from the planks from which two blocks had been tested at a time. After this the tests on the blocks from the two remaining planks were run at irregular intervals.

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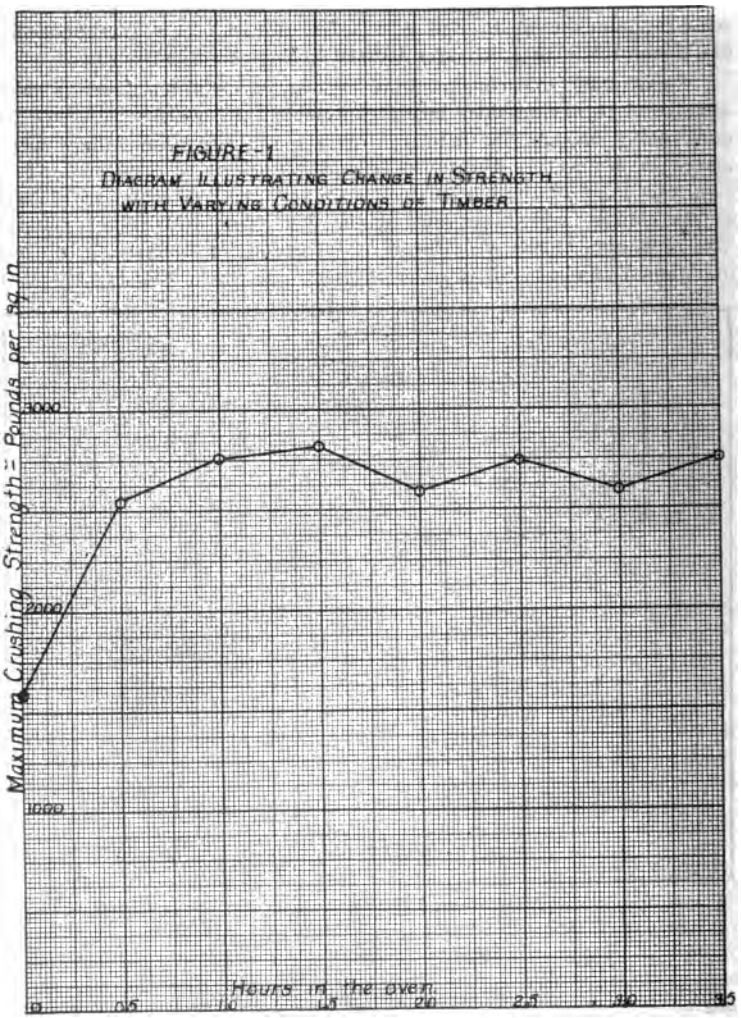


**Fig. 1.**

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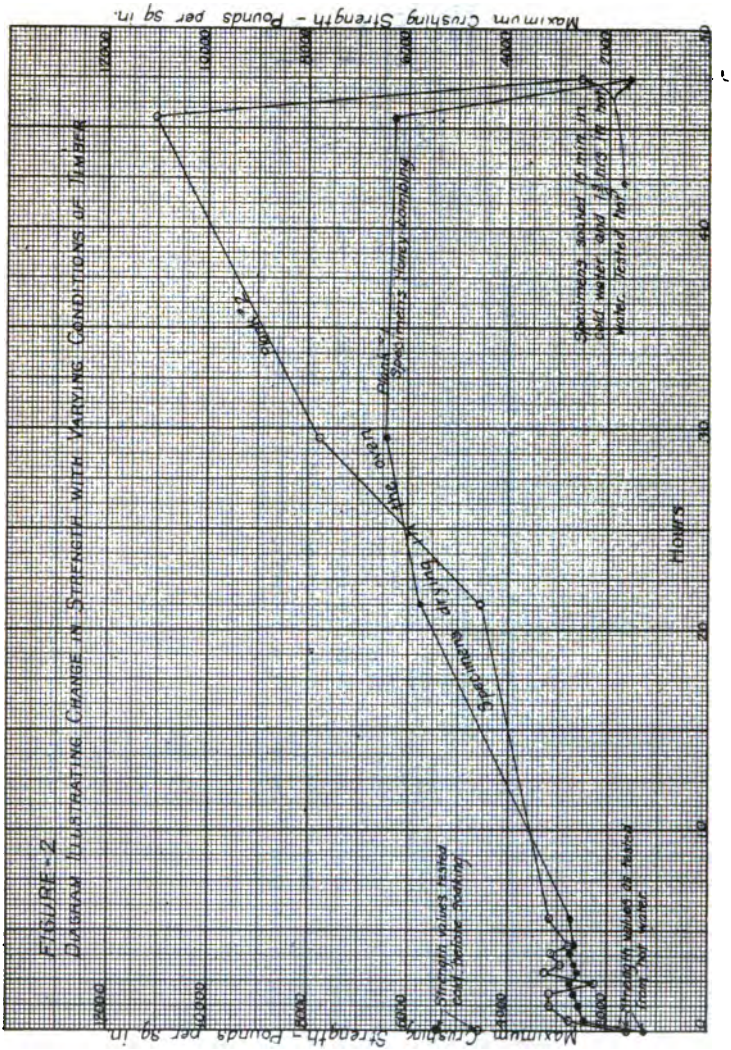
Maximum Crushing Strength - Pounds per sq in.
FIGURE 2
DIAGRAM ILLUSTRATING CHANGE IN STRENGTH WITH VARYING CONDITIONS OF TIMBER
HOURS
Maximum Crushing Strength - Pounds per sq in.

Fig. 2.

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TABLE 1.—WEIGHTS AND VOLUMES OF ENTIRE CHARGE.

| Run No. | Kind of Wood | Volume Before Treatment. Cubic Feet. | Weight—Pounds. | | | Absorption of Creosote. | | Change in Moisture. | | Amount of Condensation During Vacuum. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Before Treatment. | After Steam and Vacuum. | After Creosote Treatment. | Lbs. | Lbs. Per Cu. Ft. | Lbs. Per Cu. Ft. | Per Cent. | Lbs. Per Cu. Ft. | Per Cent. |
| 2 | Green Heartwood | 1.690 | 79.18 | 78.35 | 110.70 | 32.35 | 19.15 | −0.49 | −1.4 | 3.50 | 9.3 |
| 2 | Green Sapwood | 1.825 | 79.52 | 78.12 | 107.85 | 29.73 | 16.30 | −0.79 | −2.3 | | |
| 1 | Air-dry Heartwood | 1.922 | 85.85 | 86.17 | 114.00 | 27.83 | 14.50 | +0.17 | +0.4 | 2.16 | 6.2 |
| 1 | Air-dry Sapwood | 1.910 | 79.34 | 81.74 | 112.14 | 30.40 | 15.90 | +1.25 | +3.4 | | |

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TABLE 2.—STRENGTH TESTS OF PAVING BLOCKS.

| NATURAL | | | | | | | TREATED | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Block No. | Sap. Per Cent. | Rings. Per Inch. | Summer-wood. Per Cent. | Moisture. Per Cent. | Specific Gravity. Oven-Dry. | Max. Crush. Strength. Lbs. Per Sq. In. | Block No. | Sap. Per Cent. | Rings. Per Inch. | Summer-wood. Per Cent. | Mx. Crush Strength. Lbs. Per Sq. In. |
| **GREEN HEART.** | | | | | | | | | | | |
| A—2 | 5 | 24 | .. | 23.3 | .544 | 4180 | A—1 | 5 | 24 | .. | 4030 |
| A—4 | 5 | 24 | .. | 24.1 | .642 | 4230 | A—3 | 5 | 24 | .. | 4285 |
| B—2 | 5 | 22 | 36 | 22.7 | .550 | 5220 | B—1 | 5 | 22 | 36 | 5140 |
| B—2 | 5 | 22 | 36 | 23.3 | .562 | 4650 | B—3 | 5 | 22 | 36 | 4780 |
| Q—2 | 5 | 8 | 31 | 19.6 | .583 | 4780 | Q—1 | 5 | 8 | 31 | 4710 |
| Q—4 | 5 | 8 | 31 | 22.0 | .550 | 4660 | Q—3 | 5 | 8 | 31 | 4400 |
| R—2 | 8 | 10 | 37 | 21.9 | .610 | 4875 | R—1 | 8 | 10 | 37 | 4390 |
| R—4 | 8 | 10 | 37 | 21.7 | .572 | 4760 | R—3 | 8 | 10 | 37 | 4530 |
| S—2 | 10 | 12 | 28 | 23.0 | .525 | 4310 | S—1 | 10 | 12 | 28 | 4250 |
| S—4 | 10 | 12 | 28 | 22.8 | .559 | Cull | S—3 | 10 | 12 | 28 | 4180 |
| Ave. | 6.6 | 15.2 | 33.5 | 22.4 | .570 | 4629 | Ave. | 6.6 | 15.2 | 33.5 | 4469 |
| **GREEN SAP.** | | | | | | | | | | | |
| C—2 | 65 | 6 | 20 | 31.4 | .502 | 3790 | C—1 | 65 | 6 | 20 | 4120 |
| C—4 | 65 | 6 | 20 | 32.6 | .478 | 3660 | C—3 | 65 | 6 | 20 | 4250 |
| C—18 | 65 | 7 | 23 | 27.3 | .494 | 3740 | C—17 | 65 | 7 | 23 | 3935 |
| D—2 | 40 | 13 | 36 | 27.1 | .605 | 4500 | D—1 | 40 | 13 | 36 | 4750 |
| D—4 | 40 | 13 | 36 | 27.4 | .582 | 4540 | D—3 | 40 | 13 | 36 | 4690 |
| D—20 | 40 | 13 | 41 | 22.5 | .609 | 4330 | D—21 | 40 | 13 | 41 | 4240 |
| O—2 | 30 | 26 | .. | 21.8 | .583 | 4280 | O—1 | 30 | 26 | .. | 4130 |
| O—4 | 30 | 26 | .. | 24.1 | .533 | 4580 | O—3 | 30 | 26 | .. | 4380 |
| P—2 | 40 | 15 | 40 | 24.1 | .531 | 4710 | P—1 | 40 | 15 | 40 | 4275 |
| P—4 | 40 | 15 | 40 | 24.6 | .518 | 4610 | P—3 | 40 | 15 | 40 | 4440 |
| Ave. | 45.4 | 14 | 32 | 26.3 | .543 | 4274 | Ave. | 45.4 | 14 | 32 | 4321 |

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TABLE 2 Continued.—STRENGTH TESTS OF PAVING BLOCKS.

| NATURAL | | | | | | | TREATED | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Block No. | Sap. Per Cent. | Rings. Per Inch. | Summer-wood. Per Cent. | Moisture. Per Cent. | Specific Gravity. Oven-Dry. | Max. Crush. Strength. Lbs. Per Sq. In. | Block No. | Sap. Per Cent. | Rings. Per Inch. | Summer-wood. Per Cent. | Mx. Crush Strength. Lbs. Per Sq. In. |
| **AIR-DRY HEART.** | | | | | | | | | | | |
| H—2 | 5 | 10 | 36 | 16.6 | .705 | 5880 | H—1 | 5 | 10 | 36 | 6970 |
| H—4 | 5 | 10 | 36 | 17.9 | .656 | 6540 | H—3 | 5 | 10 | 36 | 6840 |
| I—2 | 10 | 15 | 42 | 14.9 | .647 | 5980 | I—1 | 10 | 15 | 42 | 7330 |
| I—4 | 10 | 15 | 42 | 17.0 | .578 | 6400 | I—3 | 10 | 15 | 42 | 6180 |
| J—2 | 15 | 10 | 35 | 15.1 | .579 | 5890 | J—1 | 15 | 10 | 35 | 6400 |
| J—4 | 15 | 10 | 35 | 16.6 | .570 | 5880 | J—3 | 15 | 10 | 35 | 6515 |
| K—2 | 10 | 13 | 36 | 16.5 | .592 | 6600 | K—1 | 10 | 13 | 36 | 7260 |
| K—4 | 10 | 13 | 36 | 18.5 | .582 | 5790 | K—3 | 10 | 13 | 36 | 6740 |
| L—2 | 5 | 9 | 39 | 17.3 | .687 | 6390 | L—1 | 5 | 9 | 39 | 6970 |
| L—4 | 5 | 9 | 39 | 19.0 | .703 | 6210 | L—3 | 5 | 9 | 39 | 6720 |
| Ave. | 9 | 11.4 | 37.6 | 16.9 | .630 | 6156 | Ave. | 9 | 11.4 | 37.6 | 6792 |
| **AIR-DRY SAP.** | | | | | | | | | | | |
| E—2 | 50 | 14 | 33 | 18.8 | .589 | 5490 | E—1 | 50 | 14 | 33 | 7325 |
| E—4 | 50 | 14 | 33 | 18.7 | .579 | 6080 | E—3 | 50 | 14 | 33 | 7240 |
| F—2 | 50 | 11 | 35 | 14.5 | .680 | 5460 | F—1 | 50 | 11 | 35 | Cull |
| F—4 | 50 | 11 | 35 | 16.5 | .600 | 5910 | F—3 | 50 | 11 | 35 | 6700 |
| G—2 | 60 | 13 | 33 | 16.1 | .503 | 6060 | G—1 | 60 | 13 | 33 | 6250 |
| G—4 | 60 | 13 | 33 | 15.5 | .519 | 6000 | G—3 | 60 | 13 | 33 | 5660 |
| N—2 | 50 | 11 | 44 | 19.3 | .622 | 5840 | N—1 | 50 | 11 | 44 | 6300 |
| N—4 | 50 | 11 | 44 | 19.7 | .630 | 5480 | N—3 | 50 | 11 | 44 | 6420 |
| M—2 | 45 | 12 | 33 | 15.9 | .567 | 6200 | M—1 | 45 | 12 | 33 | 6130 |
| M—4 | 45 | 12 | 33 | 17.3 | .560 | 5740 | M—3 | 45 | 12 | 33 | 4920 |
| Ave. | 51 | 12.2 | 35.6 | 17.2 | .585 | 5826 | Ave. | 51 | 12.2 | 35.6 | 6327 |

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Fig. 1 shows the average results obtained during the first 3½ hours. This curve shows a very rapid rise in strength for the first half hour in the oven, a smaller increase the second half hour, and after 1½ hours the values become irregular and in general lower. These strength changes are probably due in the greater part to changes in temperature, and to a less degree to changes in moisture and internal stresses.

While the oven was at practically the same temperature as the water the rapid evaporation of the moisture at the surface of the block would very materially lower the temperature of the interior of the block, also the drying of the ends would tend to increase the strength slightly.

After about 1½ hours the evaporation became so slow that the block began to heat up again, and the surface drying had probably caused some internal stresses. These factors combined caused the drop in the curve in this figure.

In Fig. 2 it will be seen that after about 6 hours, the blocks had again started to increase in strength, due to the loss of moisture, which counterbalanced the effect of high temperature and internal stresses. After this time the blocks increased in strength quite rapidly with loss of moisture for about 30 hours when the blocks from plank (1) began to lose, due to casehardening and honeycombing. At the end of 46 hours the block from plank (2) showed stresses more than double those of the original cold, and nearly seven times the stresses obtained from the blocks when taken from hot water. Blocks from piece (1) showed strength values five times those of the block taken from the hot water.

One block from each plank was then taken from the oven and placed in cold water for 15 minutes, the water was then heated to about 95° C., and held for 1¾ hours. Tests made at the end of this time showed stresses slightly less than one-fourth of those of the dry hot pieces tested 2 hours previously.

These results illustrate the need for caution in drawing conclusions from the results of strength tests on wood unless the conditions of test are accurately known and kept under close control. They also illustrate the possibility of drawing erroneous and misleading conclusions from tests where the full conditions under which they are made are not given.

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After reading the first full paragraph of the report, Mr. Teesdale said:

MR. C. H. TEESDALE: There was a good deal of discussion during the year as to the possible effect of the treatment required by these specifications on the strength of the wood. In order to settle this

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some tests were made on the strength of the treated blocks, and the results of these tests are given in the Appendix to our report. Both green and air-seasoned blocks were tested. Each of these groups was divided into blocks containing a considerable amount of sapwood and others which were principally heartwood, so that we had the following four groups of blocks: air-dried sapwood, air-dried heartwood, green sapwood and green heartwood. These were treated as provided by the specifications, using the maximum limits, both as to temperature and time, and obtaining roughly about 16 lbs. of preservative per cubic foot. For each treated block an untreated block was selected and tested, the selection being made so that the treated and untreated blocks had the same original strength.

A summary of the tests shows the treated green heart pieces gave average results 3½% below the corresponding natural pieces, the treated green sap pieces about 1 per cent higher than the corresponding natural pieces, the treated air-dry heart pieces ten pr cent higher than the natural pieces, and treated air-dry sap pieces gave values 8½% higher than the natural pieces. It is rather surprising that the blocks after they were steamed and given this treatment showed on the average higher strength values than the untreated blocks with which they were very carefully matched. In order to explain that some additional tests were made to show the conditions which are liable to influence strength.

(Mr. Teesdale then read the first and second paragraphs on page 462 of the Appendix.)

MR. C. H. TEESDALE: That, by the way, is a condition which can be made to exist in the same piece of wood by testing it under different conditions. It might be possible to bring the two pieces back to practically the same strength. This is further illustrated in a number of other tests which are described in the Appendix. The main point is that these results illustrate the need for caution in drawing conclusions from the results of strength tests on wood, unless the conditions of tests are accurately known and kept under close control. They also illustrate the possibility of drawing erroneous and misleading conclusions from tests where the full conditions under which they are made are not given.

Returning to the reason why the treated blocks were stronger than the untreated ones, the explanation is that internal stresses were set up in the wood during seasoning. These stresses were caused by unequal shrinkage, the outer fibers shrinking more because of more rapid drying. When the treated blocks were placed in the cylinder and steamed, the outer fibers reabsorbed moisture and relieved the internal stresses. Hence these blocks became a little bit stronger than they

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were while they still retained those stresses. Actually, the untreated and the treated blocks were of the same strength when tested under exactly similar conditions, and we may safely conclude that the treatment recommended by the Committee has no effect on the strength of the wood when it is properly carried out.

MR. M. K. TRUMBULL: That applies to the wood blocks?

MR. C. H. TEESDALE: Yes, sir, treated under these specifications. I wish to call your attention again to the work of this joint committee which met at Brooklyn. The results of that meeting were very far-reaching. They honored the American Wood-Preservers' Association by accepting practically without change the report which was presented to you last year, and as a result of that meeting the American Society of Municipal Improvements has definitely adopted the specification, with very minor changes, the American Society of Civil Engineers, a Committee of that Society has presented the report to the convention, and I understand that it probably will be adopted next year. Quite a number of cities have adopted the specifications and are now using them, and several hundred thousand square yards of blocks have been treated.

On account of the adoption of these specifications which were developed in this Association by other associations and by various cities which are now using them, I feel very strongly that the American Wood-Preservers' Association should adopt them practically without change. Mr. Chairman, I would like to move that the specifications as printed in italics and as corrected, together with the accompanying footnotes, be adopted by the Association and inserted in the MANUAL as recommended practice, and that the rest of the report which you have in your hands, and which is not printed in italics, be accepted as information.

MR. M. K. TRUMBULL: Mr. President, I second that motion, and wish to add that we should thank the Committee for its very excellent work.

MR. W. H. GRADY: Are we going to have the opportunity to discuss this?

THE PRESIDENT: Yes, sir.

MR. A. L. KUEHN: I should like to ask Mr. Teesdale to tell us why the Committee adopted the steaming of air-seasoned timber.

MR. C. H. TEESDALE: The Committee desires to steam air-seasoned timber in order to prevent or reduce bleeding troubles. Does that answer your question?

MR. A. L. KUEHN: I have some discussion on it. The expansion trouble explained is due to the additional moisture which is put

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in the wood. I have made some calculations on Mr. Newlin's supplementary report which show up a little more clearly what happens in those steaming tests. By the way, I would like to call your attention to the actual moisture content as reported by Mr. Newlin's in all cases as that within the range of the air-dry timber. For example, the material which is called green heart contained only 22.4% moisture. I think that would be easily classed as air-dry material. The sap contains 26.3%. That also I think would reasonably come within the classification of air-dry material, so that these ties are not all green sap and green heart, as most of us get them, particularly close to the mill, so that any conclusion based on that, as far as the effects of green heart and green sap are concerned would be erroneous.

Now it is possible to calculate from these tests what happens. Take that first test. The oven-dry weight is 38.3. These are calculations that I made from those and they are continued in another way in this thing, but they show up clearly the point I am making. The oven-dry weight is 38.3, and this weight is per cubic foot. The weight as treated, or as put in the cylinder as received, was 46.9, moisture content 22.4.

Now from the statement of condensation obtained the weight of that wood per cubic foot in the half of that charge, which was green heart, must have been 49.4 at the end of the 4 hours' steaming, and moisture content of 30.4%. It finished, of course, going down to 46.4 lbs. per cubic foot, and moisture content of 21.1. The other three have similar conclusions. At the end of the steaming period the second item, or the so-called green sap, contained 34.2% moisture, the next one 22.8, the next one 27.1; in other words, after you steamed it for 4 hours you had material which would come pretty close to being called air-dry material. You are putting hundreds of thousands of yards of blocks, which we are calling air-dry, and which would come under the classification so generally understood, which would be as wet as this material was after steaming. In other words, steaming material for 4 hours at the pressure shown put but very little moisture in the wood.

Now bringing out this steaming business, I have before me a calculation— I think this is vital and it gives a little clearer understanding I think of what goes on in the steaming of wood. I have never seen this made, but this is according to the law of physics. I have a calculation here based on these assumptions. I have taken the material containing a certain percentage of moisture. I have subjected that to steam and raised the temperature of the wood as well as the content of the moisture to that of the temperature of the steam. Now we place a vacuum then to reduce that moisture. That moisture is reduced by evaporation, and we have to supply enough heat to overcome the

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heat of vaporization. We pull down by this vacuum the temperature of boiling the water to a certain line. Therefore the heat available for this evaporation is the heat in the wood, and the water in the wood above that line. Applying that heat to the water in the wood we can only make a very slight change in the moisture theoretically possible. I am taking a high case here, 70% of the moisture in the wood. Applying the heat available to that reduction we reduce the temperature in that wood to about 75%. That is all you can do unless you supply outside heat somewhere. That cylinder has a vacuum in it. Therefore, the only heat you can get is through radiation in the coils. That is not much more than the radiation from the cylinder. So that the changes which we can make in temperature by this steaming process are away within the ranges of the difference in moisture in the timber as we receive it. This is theoretically correct, and you cannot quite approach that practice. This is the idea. So that I think something else takes place as the expansion is stopped in that way.

I am in doubt whether it does really effect the expansion in the street, particularly of course if the blocks lay around in the street six or eight weeks or a couple of months, that is the small change in moisture which is produced by this steaming. I am talking about air-seasoned material. Now, it will not have a material effect on the expansion feature, and it is a waste of time. Now, the bleeding, of course, we are all interested in that. Of course, we have all been looking at wood-block pavements, our own as well as the others, and I for one—of course, there may be many here that have greater observations than I have had—do not feel satisfied that I have information enough to say that the steaming of this air-dry material will prevent the bleeding. I made the statement at the last meeting to Mr. Teesdale on which he made his report. He made a report that a few blocks had been treated in this way and they showed no signs of steaming. I made the criticism that the bases of those conclusions were too small. Now I think that is an honest criticism, particularly in view of what Mr. Teesdale said as to the variability of the wood. You would have to have a great number of experiments.

In that connection the point I am trying to make—I do not want to appear as making destructive criticisms, I do not think we want that kind of criticisms, but I am going to offer some directly which I think will be constructive.

For example, Mr. Newlin's paper—now I have a high regard for Mr. Newlin's technical ability. He has been at it for a long time. I think he was hurried. Somebody brought this point up and said, now make some tests. He did the best he could in the time. His conclusions are based—well, as I heard one man say, on a hatful of blocks. That is a little bit strong, but nevertheless it shows the criticism you

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lay yourself open to when you conclude from three or four yards of blocks. I guess it is only about two yards of blocks. I just happen to have in my hand here Forest Circular No. 30. I guess it is classic enough so that everyone knows it, and it certainly covers a very much larger range of heads than is covered in this one. It proves that steam does materially affect the strength of blocks, particularly the compression endwise the grain.

I would like to sum up by saying that I would like to have the Committee make it possible that if a man wants to treat a dry material he can. He is not prevented from doing so and not considered as bad practice in the light of this Association, and if I can offer some changes in that specification a little later, I will be glad to do so.

MR. C. H. TEESDALE: I would like to ask Mr. Kuehn what is the moisture content of green heart yellow pine?

MR. A. L. KUEHN: Well, the lumberman generally figures on 4500 lbs. to the 1000 ft., that is 4½ lbs. a board foot.

MR. C. H. TEESDALE: I can state that the moisture content, both of green heart yellow pine and green Douglas fir is about 35% when first cut.

MR. A. L. KUEHN: I have weighed lumber that weighed considerably more than that, 4½ lbs. to the board foot.

MR. C. H. TEESDALE: This timber was furnished by Mr. Card, of the Central Creosoting Co. (formerly Chicago Creosoting Co.), was taken right off the car as it arrived from the mill, and the blocks were tested immediately. Now as to your criticism on the small number of blocks. They were very carefully matched and each pair of blocks was taken from a different stick, so that a variety of timber was represented. When strength tests are made on matched blocks you can get much more reliable results than you can on a very much larger number if they are not matched; in fact, one cannot draw a definite conclusion even from a very large number of tests on treated wood, even when the exact conditions under which the tests are made are known, unless the specimens are matched with each other.

MR. W. H. FULWEILER: Mr. Chairman, I just want to call your attention to one point that I think would make for greater uniformity. In the reports of the various committees on specifications they practically all use the Centigrade temperatures. I note that in the specification for the coal-tar pitch the Fahrenheit temperatures are used. I feel that it would make the technical work of the Association more uniform if we would use the same temperatures, Centigrade, throughout all our technical specifications. The temperatures used were apparently originally Centigrade and have been changed over to Fahrenheit. They use 77° F. and that is 25° C., and they use 670° F. and that is 355° C.

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MR. C. H. TEESDALE: That is satisfactory to the Committee.

MR. WALTER BUEHLER: There are certain practical considerations that must be taken into account when we treat timber for paving blocks. Timber, air-seasoned, is contracted. The subsequent oil treatment does not expand it, and when the block is made from that air-seasoned timber, and laid in the street the first rainstorm will expand it. One of the objects of steaming air-seasoned timber is to bring it back to its expanded condition, or its natural size.

We all know that we can treat blocks with 20 lbs. of oil to the cubic foot, ship them out on the street, stack them along the curb for two weeks or three weeks and allow them to season there, put them in the street, and the first rain will expand them. I know of one case where blocks were shipped to a certain street in Chicago, and for some reason or other the street could not be completed and the blocks were stored under cover for a period of about 8 months. The street was then paved with these blocks, and about two weeks after in a rainstorm the blocks expanded. They were absolutely new blocks, had been under traffic for only two weeks, they expanded in some cases as high as 2 ft. off of the concrete foundation. Now you would have exactly the same condition if you would season your timber before treatment, then treat it and put it in the street.

As to the influence on bleeding, we treat paving blocks with 16 to 20 lbs. of oil to the cubic foot. The block is a small section. There is from 75 to 80% heart, or from 20 to 25% sap on a great many of the blocks. Now take a condition where this block is thoroughly air-seasoned, you put it in the retort and apply pressure. We all know that we can put 16 lbs. of oil in very rapidly under that condition. Where does it go? It goes into the sap because it naturally follows the line of least resistance, and the sap will take it more easily than the heart, and instead of getting an average of 16 lbs. uniformly distributed through the sap and heart, you are getting most of that 16 lbs. in the sap. You are treating a part of the block. This past summer I inspected some blocks in a certain city in Illinois that were treated that way. I cut open a great many of the blocks and in every case the heartwood had absolutely no oil and the sapwood was absolutely loaded. There an investigation showed that this timber had been in the yard about 8 months and had received no preliminary steaming before treatment. We have to realize that we have a condition in the treating of paving blocks that is different than the treatment of ties or timber. I would not stand here and say you should steam air-seasoned timber or ties before treatment. It is an entirely different problem. We recommend the steaming of air-seasoned timber for paving blocks to meet a certain condition.

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Now take these blocks with the oil in the sapwood. Allow blocks to expand and you get a squeezing action which will squeeze some oil out of the sapwood. I do not claim that that is the whole reason for bleeding, but I do claim that it is a contributing factor. If we steam the seasoned timber we place that timber in condition so when we apply pressure we get a more uniform distribution of oil in the block, and I believe that is a very important consideration.

I might say in regard to these tests, there were other tests made at Purdue University. The tests were not completed in time to print, but they will be printed in the PROCEEDINGS. The tests at Purdue University were conducted by Dr. Hatt. They were made on blocks treated by the Chicago (Central) Creosoting Co. at Terre Haute, and they were divided into three groups: Treated blocks and their control tested immediately upon arrival at the University, treated blocks and their control tested after seasoning, and treated blocks and their control put in a box and covered with wet sawdust and kept in moist condition about 2 months, so that we had these three conditions: the dried block after treatment, the block that was tested immediately on arrival at the University, and the block that had been subjected to moisture. The results of these tests bear out the tests made at Madison, that there was no deterioration or reduction in strength due to the steaming. Now steaming will affect the strength of the block or will affect the strength of the timber if you carry the temperature or the pressure beyond proper limits.

We all know of the tests that were made at St. Louis during the World's Fair by Dr. von Schrenk and Professor Hatt, to determine the effect of steaming on the strength of timber. We know it was found in those tests that there were certain limits above which the strength would be affected by steaming. The tests made by the Committee show that within the limits set by this specification there is no decrease in strength.

MR. A. L. KUEHN: Mr. Chairman, the Committee makes a suggestion and recommendation in the latter part of this report that the blocks be wetted just prior to laying. I think that is one of the most important things in connection with getting successful results. Now no matter what you did with those blocks in the treatment, as far as the moisture content is concerned, Mr. Buehler or no one else that I think has studied the problem, would say that if these blocks had been laying on the street 8 or 9 months, or half of that, that under those conditions they should be laid in that street without wetting. Put the rain on them as you are laying them, and you have got something. If you change the moisture content of this wood as I have just shown by Mr. Newlin's report here, 2, 3 or 4%, and then let the blocks lay on the

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street a few weeks, you have wasted all your energy. Now there is something to this point.

Everyone who is trying to get in wood pavements say it costs too much. We are trying to reach out in the farther districts in the cities for wood blocks where we are competing with other pavements which are much cheaper. Do not do anything that is going to increase the cost of our pavements, particularly if it is doubtful that it will improve it.

Now bleeding; I have grave doubts if some of us are satisfied that we have the answer to the problem of bleeding. It appears that one of the first jobs in wood blocks I had to do with was made and treated under my direction, and it was air-seasoned timber. It was an accident. That block was laid and naturally I watched it. I saw them laying it. It was laid in front of a hotel where I had to lunch. I saw it nearly every day. That block did not bleed a drop and I know that many of us have similar instances. Now, again, there will be an example of block that was treated air-dry and which bled. I think we are in that condition right today. I do not believe that this is the answer to bleeding, and I do not think it is proved. I think the Committee should furnish us a table before we accept some of these things, similar to the report Mr. Williams had here this morning, to convince some of us. I think they want this.

Penetration: Where do you put most of the moisture when you steam the blocks? Just where Mr. Buehler says you put most of the oil, in the sapwood. Unfortunately, treating plants are subject to more or less variation. We hope that most of the time we are as fortunate as Mr. Newlin in getting the moisture back to where we started. If you do not, it is in the sapwood.

All of us know that the less water we have to contend with in treating timber the more nearly we will be satisfied with the penetration we get. Water is our enemy to good results in treating, as Mr. Rex showed us yesterday. If most of that water is in the sapwood and accidentally you do not get enough of it out, where have you got your poor penetration? Not only in the heartwood, it may be bad in the heartwood, but in the sap. Then, what have you got? You have got Charleston and St. Louis, as Dr. von Schrenk described to us last year.

MR. J. C. WILLIAMS: Mr. Chairman, I would like to ask for information of the Committee, if it knows whether this applied moisture actually goes into the wood fiber or only into the air-cells? It seems to me if the moisture only goes into the cells that it does not accomplish anything in the way of swelling up the block. You burn your fuel, produce your steam, place it in the cells of the wood, and then you take it out right away and you have incurred considerable

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expense in doing all this, but you have not accomplished anything because it takes moisture retained in the wood fiber itself to swell the blocks.

MR. WALTER BUEHLER: Mr. Chairman, it must go into the fiber for this reason, that we know moisture in the cell structure has absolutely no effect on the expansion or contraction of timber. It is only when the fiber saturation point of timber is reached that you are are changing the percentage of moisture in the fiber, that you change its size, either contracting or expanding it. Air-seasoned timber steamed will expand, so that you can only draw one conclusion, that it goes in the fiber, probably also into the cell structure, but it goes into the fiber to the extent that it will expand it back to the original size.

MR. H. G. JENNISON: I just want to say that I agree with Mr. Kuehn on almost everything he said in reference to the treatment of air-seasoned timber, and especially for paving blocks. Now if you could lay those blocks on the street just as your specification calls for, you would undoubtedly get results, but if you treat green timber at the plant, that is no insurance that those blocks are going to be expanded to the limit when they are laid in the street; as a matter of fact, you cannot tell when those blocks are to be laid. I have known blocks to be delivered in Detroit in the fall of the year and not laid until the next spring. I do not believe that the treating of green timber is going to stop buckling. That has not been my experience in laying a great many pavements around the country.

MR. C. H. TEESDALE: Mr. President, I think every one of these points is answered in the specification. For instance, the question of the buckling of steamed, air-seasoned blocks is handled on page 456 under section 5.

> The blocks shall preferably be laid in the street as soon as possible after being treated.

MR. E. B. FULKS: How much more do they cost?

MR. A. L. KUEHN: I think Mr. Teesdale has not brought out some of the practical points. After you have delivered the blocks on the street you have no control over when they are going to be laid. This paragraph says "perferably," which means nothing. They are going to be laid when conditions are such that they can be laid. Summing up what I have been saying, you let me treat air-dry material and then sprinkle them on the street before you lay them, and I will guarantee you will have no buckling and you will have better treated blocks than if you put some moisture in this sapwood.

MR. WALTER BUEHLER: Mr. Chairman, I would like to ask you this question. If you treat thoroughly air-seasoned yellow-pine blocks 75% heart with 16 lbs. of oil to the cubic foot, what, in your

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opinion, will be the distribution of the oil? What percentage of the oil will go into the sap, and what percentage will go into the heart? Do you consider it important that the heartwood be treated as well as the sap?

MR. A. L. KUEHN: I consider it more important that the sapwood be treated than the heartwood. I agree with what you said before, that the sap will take up a greater percentage of the oil. It will in your case if you steam it with this little additional moisture on a full per cent., but I do not want any condition that is going to jeopardize the solid penetration of sapwood to produce, I will say again, Charleston and St. Louis. I will give up something of the heartwood, but I will not give anything up on sap, as far as penetration goes.

MR. WALTER BUEHLER: I would like to say that if the provision in the specification in reference to pounds of pressure and time be followed, you will not jeopardize the treatment of sapwood. You will get good treatment.

MR. A. L. KUEHN: I think any of us can find an equal number of air-seasoned blocks that will show the same thing. I do not believe anyone wants to deny that. I do not know that we are getting anywhere. My idea of this thing is this: I am getting to the point that I want to be able to treat air-seasoned timber, I want to be able to do it and not be considered in bad order as far as the American Wood-Preservers' Association is concerned. To go on with these, I do not think destructive criticism is worth anything. Now if this read, "the lumber may be air-seasoned or green," then cut out, "but should preferably be treated within three months from the time."

THE PRESIDENT: We do not want to unnecessarily hurry things, but may I ask you to hurry as much as you can?

MR. A. L. KUEHN: That is what I am doing. Now I want to bring this to an end. The timber may be air-seasoned or green, and cut out the sentence, "but should preferably be treated within 3 months from the time it is sawed." Green timber and seasoned timber—do not cut this out now—green timber and seasoned timber shall not, however be treated together in the same charge. Blocks shall be treated in an air-tight cylinder with a preservative heretofore specified. Cut out, "in all cases thoroughly air-seasoned or green," and then go on, "they shall be subjected to live steam at a temperature between 200 and 240° F. for not less than 2 hours nor more than 4 hours, at the discretion of the treating plant operator, after which they shall be subjected to a vacuum of not less than 22 inches, held for at least one hour." Insert there, "for air-seasoned timber preliminary steaming may be omitted." Then add the sentence, "In case the preliminary steaming for air-seasoned timber is omitted, the pressure shall be car-

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ried up slowly until the prescribed preservative is absorbed." That latter, I think, is subject to a little more detail. I simply want to bring out the point. I move that this paragraph be modified as I have suggested.

MR. R. V. LOOK: I second the motion.

MR. C. H. TEESDALE: Mr. President, the Committee feels that those changes would jeopardize the specification, and practically ruin the work which has been done thus far through the joint committee, and it is very much opposed to the changes suggested. We do not approve of them.

MR. GEO. M. HUNT: Mr. Chairman, in order that we may all get clearly in mind the discussion, I would like to summarize a few of the points. We are going to vote on this amendment, and we want to vote with a thorough understanding of what has been said. The discussion is centered on four different points. Of these four different results that may be accomplished by steaming, one is the effect on the moisture content. Mr. Kuehn says that you get practically no change in moisture content, and if you do get a change it is all eliminated by subsequent seasoning in the street. Well, assuming that we get no change and it is eliminated by seasoning in the street, the Committee has covered that by providing for sprinkling the blocks as they are laid. That is what Mr. Kuehn suggests to prevent expansion. Therefore, Mr. Kuehn and the Committee agree upon that, but here is another thing which steaming does, that is not shown by simple moisture percentages before and after treament, and that is that we all know that the heartwood of longleaf pine and most other woods will take up creosote and will take up water with more difficulty than the sap will.

When you steam dry paving blocks your sapwood will take up water very much more rapidly than the heartwood. Your final condition of the block therefore, is that your sapwood contains more water and the heartwood perhaps a little bit less than if they were not steamed. You get a distribution of moisture which will give you better results in the end. You get a distribution of moisture rather than a change in net moisture content. The second point is bleeding. What effect has steaming on bleeding? Mr. Kuehn says it has no effect, but he does not produce any data to prove it. The Committee says it does not have an effect and produces data to prove it.

The third point is the effect on strength. Mr. Kuehn says that steaming does affect the strength. He refers to Forest Circular 39 as his authority. If you will examine that circular, I think you will find that all those experiments were made on ties and on half ties, and that the effect on strength was obtained at steam pressures above 20

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lbs., while the Committee is talking about steam pressures below 20 lbs. Therefore, the data do not apply to the case under consideration.

The Committee quotes two different series of tests in support of its contention that there is no effect on the strength. It might have quoted other tests. For instance, Department of Agriculture Bulletin 286 shows that steaming of southern yellow pine has practically no effect on strength, that is even in the form of large timber, and it is definitely proven that steaming of smaller pieces of wood has less effect on the strength than with larger pieces.

The fourth, and the one that appeals to me as the most important consideration of all, is the effect of steaming on penetration. The distribution of oil has been touched on. Tests have shown that you will get more oil in the heartwood and not such a great excess in the sapwood if you give your blocks a preliminary steaming. Dr. von Schrenk's pictures of last year were referred to, and in those pictures he showed, as I remember it, some blocks in which the decay was in the heartwood and not in the sap, and, as I remember it, he attributed that to the fact that the sapwood took all the oil and the heartwood took none. He also showed some other pictures in which the sapwood was decayed and the heartwood was not, but he said those were green blocks in which there was an excess of moisture; an excess of moisture, not just simply some moisture, and the sap did not take treatment properly. You may get decay in the heart or you may get decay in the sap, depending upon which has the better treatment.

MR. A. L. KUEHN: Mr. Chairman, pardon me for taking the time, but I believe I can answer Mr. Hunt. Mr. Hunt stated, and I believe it is claimed that this variation in the water is in the sap. I think you will recognize that. That is just the point. With the accidents in the practical operation of a treating plant which do occur in the best plants, you are jeopardizing the penetration of the sap by this extra moisture in the sap. Mr. Hunt said I produced no examples. I mentioned one and named the street, in front of the Great Northern Hotel in Chicago. I have some notes on that which I would be glad to supply. Strength: What Mr. Hunt stated about that circular is not quite in line with what this states. There are a lot of small pieces in this thing, and as far as affecting the strength is concerned, I will read here:

> Steamed for 4 hours at 20 lbs. showed compression strength parallel to the grain 79.1% of the natural.

That is seasoned loblolly pine. Now, on that point, if you do not accept this too literally, I was present when a certain lumberman asked the Bureau of Tests to make a certain set of tests of his particular material. His was better than anybody else's. The man from the

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Bureau of Tests answered him, "What do you want to prove?" I am simply stating that to show that. Take also Mr. Teesdale's statement, you can get variations of 600%. You need lots of tests to wipe out that variation and get the true answer.

MR. W. H. GRADY: Mr. President, I would like to answer the question Mr. Buehler asked about the penetration of heartwood in seasoned blocks. When you drop the oil on a charge of seasoned blocks, the end penetration, that is, the penetration on the cross-section which is parallel to the fiber, without any pressure whatever, the initial absorption we call it, will be sufficient to protect that heartwood, provided the sap is protected. The initial absorption alone will go into that heartwood sufficiently to protect that block, providing you protect the surrounding sap. As the preceding Committee was reading its report I saw something for the first time, which flashed up before me like a warning. It says, in Minneapolis:

> This pavement is failing through decay of the blocks as a result of insufficient penetration of the oil into the sapwood.

Are we going to rush head-on, with a red flag up ahead of us, like that? You state you put the water in the sapwood to keep the oil out. Now you propose to fill the sap up with water and we want the oil to go in there.

MR. WALTER BUEHLER: I would like to answer that by saying this. I have inspected a great many thousands of yards of paving in a great many cities. I have treated a great many paving blocks. I have watched this proposition for about 14 years, and I say as a positive fact that in every case where the timber was seasoned before it was treated there has been trouble from expansion.

Mr. Ericson, in Chicago in 1911, made a very detailed report of all the streets laid in Chicago up to that time, and in this report he showed the trouble due to bleeding and the trouble due to expansion, and a very significant fact stands out in that report. That one company that had made it a practice to treat practically from car to plant had the least trouble due to expansion, that one company that had made it the practice to keep from a million to a million and a half feet of lumber in its yards had the most trouble due to expansion, and I claim this was due absolutely to the seasoning of the timber before treatment.

MR. A. L. KUEHN: I would like to ask Mr. Buehler if it is not a positive fact that it has not been the practice to wet the blocks as is recommended by this Committee?

MR. WALTER BUEHLER: That it has not been the practice?

MR. A. L. KUEHN: That it has not been the practice; that the opposite has been the practice.

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MR. WALTER BUEHLER: You mean before treatment, or on the street?

MR. A. L. KUEHN: On the street.

MR. WALTER BUEHLER: I would not say that. I say it has been the practice in a great many cities. You could not answer that by yes or no.

MR. A. L. KUEHN: Did they in Chicago?

MR. WALTER BUEHLER: Some cities have followed that practice, and other cities have not.

MR. E. B. FULKS: Who took this Ericson report in Chicago?

MR. C. H. TEESDALE: I would like to point out again that if this specification is followed the points which seem to be bothering you gentlemen will not come up. Under inspection it provides that the blocks shall be treated through and through. The blocks are not to be accepted if they are not thoroughly penetrated. A definite procedure is provided for obtaining that result. I want to point out also that the remarks being made here have not been supported by data, whereas the work of the Committee is all based upon data which has been published.

THE PRESIDENT: Gentlemen, I believe we have given about all the time we can give to this discussion, and it has been pretty largely confined to a few. I have tried to give everyone a fair chance, but the discussion has not been very generally participated in. Unless there is someone that has something particular to say at this time, I think we will have to put the amendment to the original motion. However, if there is somebody that wishes to cover some point that has not already been covered or touched upon, I will be glad to give you a moment's time for the presentation of your remarks.

MR. L. B. MOSES: I do not wish to undertake any discussion of the question at all further than to say it seems to me that the specification as recommended by the Committee will certainly place more of an obligation on the manufacturers to follow this material through and see that it is properly handled after treatment than would be the case if the amendment were adopted. For that reason, above everything else, I should be in favor of the Committee's report.

MR. W. H. GRADY: Mr. President, I think every time you go to a man with a proposition about wood-block pavement, the first thing he says to you is "Too expensive." The most expensive way of putting water in blocks is to steam them and prolong the operation up to 10 or 12 hours. You can effectively treat seasoned blocks in 3 or 4 hours. Now it would be a good deal cheaper to put the water in on the street with a hose than to burn up the coal in the boiler. It is agreed by all

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that the water put in by steaming will not remain in the blocks unless they are laid in the street promptly. As these are seldom laid promptly why pay freight on water? Now as to treating green blocks. Most all the southern pine mills try to at least partly season block lumber for northern shipments in order to save freight. Sometimes even kiln-dry it. Think of the extra cost of blocks caused by freight on green lumber, say to Detroit, Chicago, Minneapolis or New York, from the pine mills near the Gulf of Mexico.

MR. WALTER BUEHLER: Mr. President, I do not want to unnecessarily prolong this discussion, but the question of cost does not enter into the question of steaming to the extent which it has been intimated it would. The plant cost is a very small percentage of the cost of the finished pavement, and I doubt whether the cost would be affected a fraction of 1%.

THE PRESIDENT: Gentlemen, we have the motion before us to adopt the Committee's specification, and that has been amended to change certain sentences, as read by Mr. Kuehn. Before I put this amendment I just want to put the two propositions before you, as I see it so far as this Association is concerned, and I say this as your President in trying to push forward the best interests of the Association. We have on the one hand here a report in which our chosen Committee has prepared and given a year of study and time in preparing it, and that they, or representatives of this Association, have met with representatives of other associations, and they have practically taken this report and agreed to recommend it to their associations, and ask them to adopt it. On the other hand, we, as an Association, do not want to adopt standards which are not right, or as nearly right as we can get them at this time. I do feel that we should adopt specifications, and we want them as nearly right as possible.

I ask all of you to bear these points in mind, and those which have been brought out by the discussion, in voting on this question, and I will now put the amendment to the report as read by Mr. Kuehn. All those who are in favor of the amendment will please signify it by saying "aye"; all those opposed, "no." I will ask you to take a standing vote on it. All those who are in favor will please rise to your feet. All those that are opposed please rise to your feet. The motion is lost.

Now we will go back to the original motion to accept these specifications and adopt them as recommended practice, to be published in the MANUAL.. All those in favor of the motion will please signify it by saying "aye"; those opposed, "no." The motion is carried. That includes the acceptance of the remainder of the report as information.

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MR. C. H. TEESDALE: Under recommendations for future work, I had pointed out to me the question of preparing specifications for interior wood-block flooring, and the Committee has no objection to including that in the recommendations for next year.

MR. RICHARD V. LOOK: Mr. President, we have a good deal of very valuable information covering the use of wood blocks for outside work, but we have not a great deal covering the use of the same blocks indoors, and I would suggest that the Committee for next year be instructed, and I put it in the form of a motion, if I am in order, that it be instructed next year to bring in recommendations covering blocks for indoor work, including a recommendation as to a method to prevent shrinkage as much as possible, after having been laid in the floor, and a recommendation covering the number of pounds per cubic foot that they would recommend as being best practice, and further a recommendation that when blocks are sold for interior work the number of pounds per cubic foot be specified, so that the purchaser may know what he may expect to get.

THE PRESIDENT: Is there a second to this motion?

MR. A. L. KUEHN: I second the motion.

THE PRESIDENT: You have heard the motion as a suggestion for the work of next year's Committee. I believe that the suggestions are the result of a lack of information which has been experienced by men furnishing interior blocks. All of those in favor of the motion signify it by saying "aye"; all those opposed, say "no." The motion is carried.

MR. H. I. GOLDSTEIN: I would like to make a recommendation for the Committee to look up and suggest means of testing the amount of oil in wood blocks by chemical means.

Most of the men who are at the plants have long hours, men who employ them think they can stay 24 hours a day; that is, by questions they ask they seem to expect them to do it. Whether they can or not is a question. I know I cannot; therefore I would like to have the Committee find a method of testing the number of pounds of oil per cubic foot in the laboratory as a check on the treating plant.

Another thing to do is to find a method of taking samples from barges and cars. There was a paper presented in 1914 showing how hard it was to take a sample from a barge and a car. That question has not been taken up since, and I would like to have it look that up too.

Another suggestion, about these specifications, I would like to have a copy of one of them sent to each of the city engineers who lay wood-block pavement. I think the men who are talking about promotion and publicity cannot find anything better to send out than a report like this,

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showing that this society is taking the initiative, bringing other associations together and making up a specification of this sort.

THE PRESIDENT: Gentlemen, if there is nothing further the Committee will be excused, with the thanks of the Association for its work.

The next thing is the report of the Committee on Resolutions. I will ask the Chairman to come forward and present this report. I hope the members will have patience with us until we get through. We will soon finish the work for the entire session.

MR. WM. A. FISHER: This communication has been handed to the Committee on Resolutions:

To THE RESOLUTIONS COMMITTEE:

The ladies attending the Thirteenth Annual Meeting of the American Wood-Preservers' Association, having been the guests of Mrs. Harrington Emerson at a most enjoyable dinner and theatre party, wish to express their thanks and appreciation of Mrs. Emerson's kindness, and ask that this acknowledgment be given place in the PROCEEDINGS of the Association.

MRS. F. J. ANGIER,
MRS. E. W. BRIGHT,
MRS. WILLIAM A. FISHER,
MRS. F. D. MATTOS,
MRS. C. M. TAYLOR,

*Committee.*

MR. WM. A. FISHER: I move you that this communication be given a place in the PROCEEDINGS of the Association.

MR. H. I. GOLDSTEIN: I second the motion.

THE PRESIDENT: All those in favor of the motion please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. WM. A. FISHER: We have also this communication:

To THE RESOLUTIONS COMMITTEE:

The ladies attending the Thirteenth Annual Meeting of the American Wood-Preservers' Association wish to express to the Entertainment Committee their thanks and appreciation for the many provisions made for their entertainment and pleasure, and the splendid arrangements that have made their stay in New York one long to be remembered.

MRS. F. J. ANGIER,
MRS. E. W. BRIGHT,
MRS. WILLIAM A. FISHER,
MRS. F. D. MATTOS,
MRS. C. M. TAYLOR,

*Committee.*

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MR. WM. A. FISHER: I move this also be included in the PROCEEDINGS

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. WM. A. FISHER: We now submit the report of the Committee on Resolutions.

## REPORT OF COMMITTEE ON RESOLUTIONS.

*To the Members of the American Wood-Preservers' Association:*

Your Committee endorses the precedent set by the Resolutions Committee of last year, in that the formal complimentary resolutions of former years are omitted. The present Committee joins with the full membership of the Association in its appreciation of the conscientious, constructive work which has characterized the administration of the Association's affairs during the past year, but believes that formal expression of this sentiment is unnecessary.

The Committee feels also that yesterday's action by the Convention in thanking Messrs. Rex and Waterman for their interesting talk and pictures renders further comment unnecessary.

The following subject has been suggested to the Committee and is offered to the Association for its approval:

WHEREAS, It is highly desirable that the interests of the wood-preserving industry be advanced in every legitimate way;

RESOLVED, That the suggestions of the Committee on Publicity, Promotion and Education are heartily endorsed, and that the full co-operation of the membership be offered at every opportunity to improve the work along these lines.

WILLIAM A. FISHER, *Chairman*
F. D. MATTOS
C. M. TAYLOR

MR. WM. A. FISHER: I move the adoption of this resolution.

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: All those in favor of adopting this resolution as read please signify it by saying "aye"; contrary, "no." The motion is carried.

The next in order is New Business.

MR. L. B. MOSES: Mr. President, I would like to suggest just two matters for the attention of the proper committee, or for attention in such way as may be proper. One is in connection with the fire-

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proofing of shingles and other materials in connection with the preservation of material. The thing has been discussed quite a good deal by the members at this meeting, a good deal of it was entirely new, and it seems to me a great deal of it would be interesting to the members of this Association. It is merely a suggestion for investigation by the proper standing committee next year. In the same way a suggestion that some investigation and report be made on open-tank treatments, for next year, going further than the HANDBOOK reference or the Committee on Terminology's reference in this year's report. It seems to me there are a good many places where it is proper to advocate open-tank treatment that we do not know about, and a great many places where it is now improperly advocated that we also do not know about. We ought to know both sides of the thing.

THE PRESIDENT: Anything further? We will now have the announcement of the election results by the tellers.

MR. S. D. COOPER: Mr. President and Gentlemen: The result of the Election is as follows: For President, John Foley (applause); for Vice-President, M. K. Trumbull (applause); for Second Vice-President, J. B. Card (applause); for Secretary-Treasurer, F. J. Angier (applause). For Executive Committee, three years, V. K. Hendricks and C. M. Taylor; for Nominating Committee, W. A. Fisher, E. T. Howson, R. V. Look, F. D. Mattos, August Meyer and A. H. Noyes (applause).

THE PRESIDENT: I will ask Mr. Moses and Mr. Davidson to escort the new President to the Chair.

(Mr. Foley was then escorted to the Chair.)

EX-PRESIDENT CRAWFORD: Gentlemen, I think you made a wise choice.

PRESIDENT-ELECT FOLEY: To attempt to say in appreciation of what you have done for me what I appropriately should would take more time that I am sure you wish to give at this late stage in your sessions. All I can ask for is that the loyalty to the interests of the Association, which has been manifested by your attendance here be given throughout the year. Then there will be no question about the results we will have in 1917. Thank you (applause).

Now, if Mr. Trumbull will be escorted by the same delegation that brought me to the Chair, I will appreciate it. (Applause.)

(Mr. Trumbull escorted to the rostrum.)

MR. M. K. TRUMBULL: I thank you from the bottom of my heart for the honor you have conferred upon me. The Association is in splendid hands with Mr. Foley as its President and Mr. Angier as its Secretary-Treasurer. I am quite sure that we can expect from

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them individually and in co-operation the best of harmony and the best of policies. The Vice-Presidents and the members of the Executive Committee and all of the Committees will endeavor to do their work acceptably. The uppermost thought I now have in my mind is a fervent hope that, when we meet again, a year hence, the terrible nightmare of world war will have passed; the United States and humanity will have profited by the results; more constructive statesmanship will have been established; and the principles of universal peace will have been set forth in such manner that we may never fear the like will occur again. Thank you (applause).

EX-PRESIDENT CRAWFORD: Mr. President, if I am in order, I would just like to make an announcement. I would like to see the members of the old Executive Committee immediately after we adjourn.

PRESIDENT-ELECT FOLEY: I am glad to see that there are enough of them present to make a quorum when we meet. Is Mr. Card present? Well, all of you know Joe Card, and while he is not here to be presented to you, the rest of us who have worked with him in the past know that he is going to do his share towards keeping the Association on an upward trend. Mr. Angier needs no introduction. I am sure you will be glad with me to have him continue in the harness (applause.)

MR. F. J. ANGIER: Mr. President and Gentlemen: This will be the eighth time I have made my little speech, sweet and to the point. I thank you for the honor, and assure you that I will do my best to work for the Association's interests the coming year (applause.)

PRESIDENT-ELECT FOLEY: I can think of no other business that we need to transact before the new officers have a chance to find out how much they can do of the much there is to be done, so I will be glad to entertain a motion to adjourn.

MR. W. F. GOLTRA: I move we adjourn.

MR. W. H. FULWEILER: I second the motion.

PRESIDENT-ELECT FOLEY: It has been regularly moved and seconded that the Thirteenth Annual Meeting of the American Wood-Preservers' Association stands adjourned. Those in favor will say "aye"; contrary, "no." The motion is carried. We hope to see all of you in Chicago this time next year.

An adjournment was then taken.

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# STATISTICAL DATA

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# QUANTITY OF WOOD TREATED AND PRESERVATIVES USED IN THE UNITED STATES IN 1916.

By R. K. Helphenstine, Jr., U. S. Forest Service.

The American Wood-Preservers' Association

In co-operation with the United States Department of Agriculture, Forest Service, Henry S. Graves, Forester; Office of Industrial Investigations, H. S. Betts, Engineer in Forest Products, in Charge.

## Summary.

In 1916 a total of 150,522,982 cubic feet of wood was treated by the 117 treating plants which were active during the year. This is 9,664,019 cu. ft., or 6.9% more than the 140,858,963 ft. of material treated by the 102 plants which reported in 1915.

An increase of 383,783, or 2.5%, was recorded in the number of cross-ties treated during 1916 over the number reported in 1915, while the quantity of piling treated was more by 3,382,448 linear feet, or 36.3%. A gain of 852,171 sq. yds. was also made in the quantity of paving material treated, while the number of cross-arms was greater in 1916 than in 1915 by 145,559, or 99.5%. The largest increase occurred in the number of poles treated, which amounted to more than twice the number reported during the previous year. In only two of the seven classes of material covered by the report were decreases registered in the quantity treated. The items consist of construction timber and miscellaneous lumber and the amounts given fall short of the 1915 figures by 3,119,819 and 913,509 board feet respectively.

The quantity of preservatives used by the industry during 1916 in the treatment of the 150,522,982 cu. ft. of wood reported amounted to 90,404,749 gallons of creosote and refined water-gas-tar, 26,746,577 pounds of zinc chloride, 5,675,095 gallons of paving oil and 582,754 gallons of miscellaneous preservatives. The amount of creosote and refined water-gas-tar used was greater in 1916 than in the year previous by 9,545,307 gallons, while a decrease of 6,523,027 pounds was recorded in the consumption of zinc chloride. The quantity of paving oil reported exceeded the 1915 figures by 2,469,532 gals., and of miscellaneous preservatives was less than one-third of the 1915 consumption.

## Source of Statistics.

In the compilation of the 1916 statistics a carefully prepared mailing list was used, which comprised a total of 128 plants of all types. The treating plants of the United States have been considered under

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TABLE 1.—TREATING PLANTS IN THE UNITED STATES, 1916.

| Status | COMMERCIAL | | | RAILROAD | | | PRIVATE | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pressure | Non-pressure | Pressure and non-pressure | Pressure | Non-pressure | Pressure and non-pressure | Pressure | Non-pressure | Pressure and non-pressure | |
| Active | 62 | 5 | 4 | 27 | 1 | 1 | 5 | 11 | 1 | 117 |
| Idle | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 5 | 0 | 7 |
| Abandoned | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 4 |
| Total | 62 | 7 | 4 | 28 | 1 | 1 | 5 | 19 | 1 | 128 |

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three main classes of commercial plants, railroad plants and private plants. They are further divided into pressure plants, non-pressure plants and those equipped for both kinds of treatment. The number and type of each class included in the list used, together with the number which were active, idle or abandoned during the year are shown in Table 1.

Of the 117 plants shown as being active during 1916, a total of 110 furnished signed schedules of their activities for the period covered by the report. For the remaining seven estimates were computed, based on the reports submitted by other plants of the same type and relative equipment. This was done to make the statistics more complete and to harmonize the 1916 figures with those for 1915, in connection with the compilation of which similar estimates were made for several delinquent plants.

The gradual increase from year to year in the quantity of preservatives consumed and the corresponding increase in material treated is indicative of the growth of the industry. Extensive research work in reference to the treatment of wood, covering plant equipment, specifications for preservatives, processes and similar scientific investigations has resulted in more or less standardization along these lines.

As shown in Table 1, most of the treating plants of this country are of the pressure-cylinder type. The data presented in this report cover only the consumption of preservatives and material treated by those establishments which maintain treating-plant equipment. It does not include brush-treated material or that treated with temporary apparatus in small amounts for special purposes. Consumers of this character are so numerous that it would be a difficult matter to obtain such statistics.

As customary in conducting this work, the statistics were collected entirely by correspondence. All individual reports are considered confidential, and the amounts are published in a manner not likely to disclose the operations of individual plants. In view of the broad field covered by the work, it is felt that the statistics as presented portray the activities of the industry as a whole as completely and accurately as practicable.

The objects in collecting the statistics are:

1. To show the progress of wood preservation in the United States.
2. To indicate the relative demand for the different preservatives in the various regions of the United States.
3. To show the amount of timber treated by species and classes of material as an aid for suggesting new fields of development for individual treating plants.

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4. To show the quantities of imported and domestic creosote consumed, thus pointing out the principal sources of supply.

### Consumption of Preservatives.

Table 2 shows the consumption of wood-preservatives used by the treating plants in the United States by years and kinds of preservatives. An increase in the quantity of creosote consumed is shown for each year from 1909 to 1913, the latter year indicating the greatest consumption so far reported by the industry. The amount used in 1916 shows an increase of 9,545,307 gallons, or 11.8%, over the quantity reported in 1915. Since 1914 paving oil has been shown separately, while for previous years it was included in the figures given for creosote. The consumption of paving oil in 1916 was 5,675,095 gallons, or 2,469,532 gallons more than was reported by the plants in 1915.

During 1916 a total of 26,746,577 pounds of zinc chloride was used by the treating plants of this country, which amounts to 6,523,027 pounds, or 19.6%, less than the quantity reported in 1915. Approximately one-fourth of the total quantity used was reported in 50% solution.

TABLE 2.—CONSUMPTION OF WOOD PRESERVATIVES BY THE TREATING PLANTS OF THE UNITED STATES, 1909 TO 1916.

| Year | Number of plants | Creosote(d) | Zinc chloride | Other preservatives(a) |
|---|---|---|---|---|
| | | *Gallons* | *Pounds* | *Gallons* |
| 1909 | 64 | 51,431,212 | 16,215,107 | (b) |
| 1910 | 71 | 63,266,271 | 16,802,532 | 2,333,707 |
| 1911 | 80 | 73,027,335 | 16,359,797 | 1,000,000 |
| 1912 | 84 | 83,666,490 | 20,751,711 | 3,072,462 |
| 1913 | 93 | 108,373,359 | 26,466,803 | 3,885,738 |
| 1914 | 94 | 79,334,606 | 27,212,259 | 9,429,444(c)<br>2,486,637 |
| 1915 | 102 | 80,859,442 | 33,269,604 | 3,205,563(c)<br>1,693,544 |
| 1916 | 117 | 90,404,749 | 26,746,577 | 5,675,095(c)<br>582,754 |

(a) Includes refined coal-tar, corrosive sublimate, sodium fluoride, and carbolineum oils.
(b) Statistics not available.
(c) Paving oil.
(d) Includes coal-tar creosote and water-gas-tar.

It will be noted that the quantity of miscellaneous preservatives reported for 1916 is less by over 1,100,000 gallons than the figure given for the 1915 consumption.

Table 3 shows the range of prices paid for creosote and zinc chloride for both 1915 and 1916 by regions.

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TABLE 3.—PRICES PAID FOR PRESERVATIVES, 1915 AND 1916.

| Region | 1915 | | 1916 | |
|---|---|---|---|---|
| | Creosote (Per gallon) | Zinc chloride (Per pound) | Creosote (Per gallon) | Zinc chloride (Per pound) |
| Altantic Coast | $0.07 to $0.09 | $0.038 .... | $0.075 to $0.09 | $0.06 ... |
| Southern Coast | .064 " .1084 | .03 to $0.065 | .08 " .1014 | .0325 to $0.095 |
| Interior Eastern | .07 " .095 | .035 " .0675 | .075 " .095 | .058 " .075 |
| Interior Western | .075 " .135 | .033 " .0475 | .075 " .135 | .0533 " .074 |
| Pacific Coast | .075 " .13 | .035 " .0473 | .075 " .135 | .0533 " .065 |

NOTE.—Does not include refined water-gas-tar, which ordinarily costs about one-half the price of coal-tar creosote.

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Table 4 shows the monthly importation of creosote in 1915 and 1916. The total for 1916 indicates that the treating plants consumed slightly less than was reported as having been imported into the United States. This difference may be accounted for by the fact that the treating plants probably did not use all of the foreign oil purchased and for the reason that some of the excess was no doubt employed in the brush treatment of wood, the manufacture of preservative paints or stains and for similar miscellaneous purposes.

TABLE 4.—MONTHLY IMPORTS OF CREOSOTE INTO UNITED STATES, 1915 AND 1916.*

| Month | 1915 | 1916 |
|---|---|---|
| | *Gallons* | *Gallons* |
| January | 178,841 | 5,477,439 |
| February | 2,058,635 | 2,722,797 |
| March | 1,108,970 | 5,121,242 |
| April | 2,547,635 | 5,657,982 |
| May | 7,173,847 | 3,757,459 |
| June | 5,220,554 | 1,608,927 |
| July | 2,060,815 | 6,919,870 |
| August | 1,511,986 | 2,765,121 |
| September | 3,870,050 | 3,442,296 |
| October | 4,683,304 | 1,554,169 |
| November | 3,712,782 | 5,279,003 |
| December | 314,609 | 2,538,112 |
| Total | 34,442,028 | 46,844,417 |

*Monthly summary of Foreign Commerce of the United States Bureau of Foreign and Domestic Commerce.

The relative quantities of foreign and domestic creosote used in 1916 are shown in Table 5. The importation for 1916 is greater than for the previous year by 6,148,924 gallons, or an increase of 16.4%. Of the total amount of foreign oil reported by the plants 41,531,091 gallons were obtained from England, 962,839 from Japan, 741,611 from Canada and 414,390 from Germany.

TABLE 5.—QUANTITIES OF DOMESTIC AND IMPORTED CREOSOTE USED IN THE UNITED STATES, 1909 TO 1916.

| Year | creosote used Total | creosote Domestic | of total Per cent | creosote Imported | of total Per cent |
|---|---|---|---|---|---|
| | *Gallons* | *Gallons* | | *Gallons* | |
| 1909 | 51,426,212 | 13,862,171 | 27 | 37,569,041 | 73 |
| 1910 | 63,266,271 | 18,184,355 | 29 | 45,081,916 | 71 |
| 1911 | 73,027,335 | 21,510,629 | 29 | 51,516,706 | 71 |
| 1912 | 83,666,490 | 31,135,195 | 37 | 52,531,295 | 63 |
| 1913 | 108,373,359 | 41,700,167 | 38 | 66,673,192 | 62 |
| 1914 | 79,334,606 | 28,026,870 | 35 | 51,307,736 | 65 |
| 1915 | 80,859,442 | 43,358,435(a) | 54 | 37,501,007 | 46 |
| 1916 | 90,404,749 | 46,754,818(b) | 52 | 43,649,931 | 48 |

(a) 41,333,890 gallons coal-tar creosote and 2,024,545 gallons water-gas-tar.
(b) 45,318,735 gallons coal-tar creosote and 1,436,083 gallons water-gas-tar.

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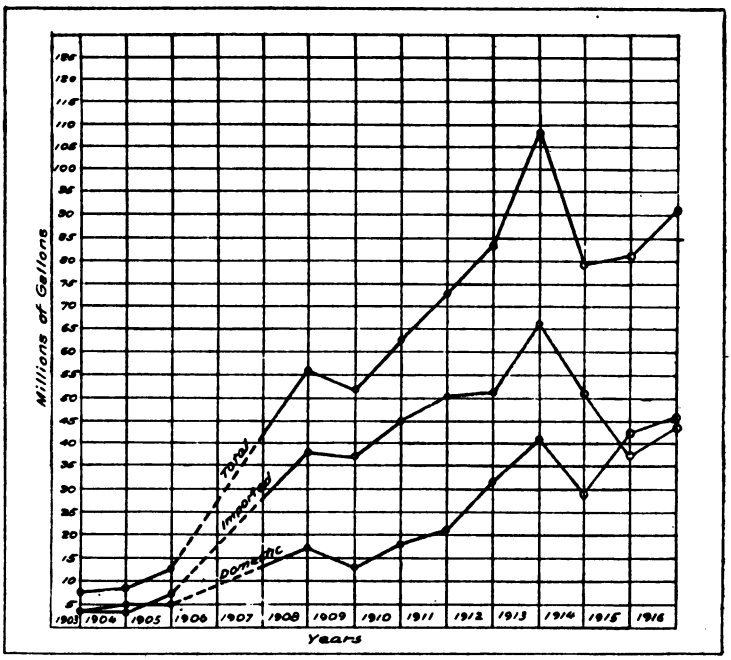
PROGRESS OF WOOD PRESERVATION IN THE UNITED STATES.
Consumption of Creosote, 1903-1916.




Note: Figures not available for years 1906-1907.
OFFICE OF INDUSTRIAL INVESTIGATIONS, U. S. FOREST SERVICE.

**Regional Division of the Wood-Preserving Industry.**

In compiling the statistics on wood preservation in the United States the total area of the country has been divided into five main divisions, as shown on the accompanying map. Table 6 gives the figures for these regions and shows both the quantity of preservatives consumed and the amount of material treated by the plants embraced in each region. The material is here shown in the form and quantity as reported by the plants instead of in cubic feet as presented in Table 10.

The divisions shown were made with a view of conforming the areas embraced as far as practicable to the Forest Service subdivisions into which this country's original forests have been divided. The divisions referred to are as follows:

1. ATLANTIC COAST REGION, embracing the Northern Forest, made up largely of white pine, spruce, hemlock, tamarack and their associated species.

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TABLE 6.—MATERIAL CONSUMED IN WOOD PRESERVATION IN UNITED STATES, 1915 AND 1916.

| Region | Year | Number of plants | Domestic creosote | Foreign creosote | Zinc chloride | Other preservatives | Hewed ties | Sawed ties | Piles | Poles | Paving blocks | Construction timber | Cross-arms | Miscellaneous |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *Gallons* | *Gallons* | *Pounds* | *Gallons* | *Number* | *Number* | *Lin. ft.* | *Number* | *Sq. yds.* | *Bd. ft.* | *Number* | *Bd. ft.* |
| Atlantic Coast | 1915 | 20 | 12,277,532 | 17,959,083 | 2,077,877 | 50,080 | 5,339,088 | 2,089,847 | 3,500,821 | 11,697 | 552,095 | 28,298,805 | 16,757 | 4,634,655 |
| | 1916 | 21 | 15,240,997 | 8,805,439 | 1,879,376 | 148,550 | 3,809,070 | 1,707,910 | 4,347,824 | 12,992 | 405,267 | 30,108,195 | 18,425 | 2,761,503 |
| Southern Coast | 1915 | 27 | 10,774,698 | 15,079,315 | 9,767,867 | ..... | 8,519,038 | 439,255 | 3,817,927 | 66,216 | 806,968 | 77,798,523 | 121,945 | 3,658,227 |
| | 1916 | 31 | 13,722,940 | 24,206,836 | 5,827,206 | 389,066 | 8,524,223 | 2,527,785 | 5,539,949 | 138,656 | 1,141,063 | 69,260,630 | 197,103 | 7,773,725 |
| Interior Eastern | 1915 | 29 | 20,594,325 | 1,739,349 | 12,764,798 | 1,640,102 | 10,403,406 | 4,246,896 | 138,639 | 32,503 | 1,509,755 | 18,914,931 | 2,211 | 1,809,064 |
| | 1916 | 33 | 20,301,735 | 5,712,796 | 12,818,944 | 24,000 | 12,373,774 | 2,820,966 | 75,301 | 102,233 | 1,827,327 | 20,871,615 | 11,905 | 950,038 |
| Interior Western | 1915 | 10 | 1,809,854 | 585,557 | 6,441,138 | ..... | 1,475,478 | 2,526,400 | 3,010 | 3,107 | 1,000 | 6,628,575 | 56 | 3,398,959 |
| | 1916 | 14 | 1,093,620 | 1,904,804 | 3,967,535 | 2,002 | 1,731,386 | 1,569,879 | 120,250 | 11,441 | ..... | 8,563,644 | 78 | 1,186,539 |
| Pacific Coast | 1915 | 16 | 1,107,589 | 2,137,703 | 2,217,924 | 3,362 | 94,194 | 1,951,983 | 1,848,022 | 12,116 | 66,552 | 10,368,207 | 5,250 | 436,604 |
| | 1916 | 18 | 2,070,743 | 3,020,056 | 2,253,516 | 19,136 | 61,501 | 2,342,874 | 2,607,543 | 63,195 | 414,884 | 10,085,138 | 64,267 | 352,195 |
| Grand total | 1915 | 102 | 43,358,435 | 37,501,007 | 33,269,604 | 1,693,544 | 25,831,204 | 11,254,381 | 9,308,419 | 126,056 | 2,936,370 | 142,009,041 | 146,219 | 13,937,509 |
| | 1916 | 117 | 52,430,035 | 43,649,931 | 26,746,577 | 582,754 | 26,499,954 | 10,969,414 | 12,690,867 | 328,517 | 3,788,541 | 138,889,222 | 291,778 | 13,024,000 |

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2. SOUTHERN COAST REGION, which practically covers the territory included in the Southern Forest where the yellow pines predominate.

3. INTERIOR EASTERN REGION, comprising the Hardwood Forest, the only region in the United States where the hardwoods, such as oak, maple and beech, predominate.

4. INTERIOR WESTERN REGION, coinciding with the Rocky Mountain Forest, throughout which western yellow pine occurs in company with lodgepole pine, larch, and other softwoods.

5. PACIFIC COAST REGION, the area covered by the Pacific Forest, where conifers such as Douglas fir, redwood, and western yellow pine occur almost to the exclusion of hardwoods.

**Consumption of Preservatives and Treatment of Material.**

ATLANTIC COAST REGION.

There was used by the 21 active plants of this region a total of 24,046,436 gallons of creosote and refined water-gas-tar, of which 15,240,997 gals. were of domestic and 8,805,439 gals. of foreign manufacture. As was the case in 1915 the consumption of zinc chloride in this region was least, amounting to 1,879,376 pounds. Nearly 150,000 gals. of miscellaneous preservatives were employed by the plants of the region.

The total number of cross-ties treated in 1916 was less by 1,911,955 than during the previous year, while the quantity of piling exceeded the 1915 figures by 847,003 linear feet. The 12,992 poles and the 30,108,195 board feet of construction timber treated by the plants of the region represent increases over the amounts reported for 1915 of 1,295 board feet of the former and 1,809,390 board feet of the latter. The quantity of paving blocks and miscellaneous material reported in 1916 are less than for the year previous by 146,828 sq. yds. and 1,873,152 board feet, respectively. A slight increase, amounting to 1,668 pieces, was registered in the treatment of cross-arms.

SOUTHERN COAST REGION.

This region headed the list in 1916 in the consumption of creosote, the total amount used by the 31 reporting plants being 37,929,776 gals., of which 13,722,940 were of domestic and 24,206,836, or nearly twice as much, of foreign manufacture. The region stood second in point of zinc-chloride consumption, the quantity used being 5,827,206 lbs. or slightly more than half the amount reported in 1915. Nearly two-thirds of the total amount of miscellaneous preservatives reported for the entire United States were used by the plants of the Southern Coast Re-

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gion in 1916, the quantity being 389,066 gals., where none was employed in the year previous.

Increases occurred in the quantity treated by the plants of this region in 1916 over 1915 in all but one of the seven classes of material shown in Table 6. The one class which showed a less amount was construction timber, of which there was treated 69,260,630 board feet as compared with 77,798,523 for the year before.

INTERIOR EASTERN REGION.

This region contains the greatest number of plants. The total of 33 which reported consumed the largest quantity of zinc chloride and next to the largest amount of creosote. Of the former 12,818,944 lbs. were used, and of the latter 26,014,531 gals. The plants of the region also employed 24,000 gals. of miscellaneous preservatives.

The number of cross-ties treated by these plants was greater in 1916 than in 1915 by 544,438, while the quantity of piling was less by 63,338 linear feet. Over 60,000 more poles, 317,572 more sq. yds. of paving blocks, 9,694 cross-arms and 1,956,684 board feet of construction timber were reported treated in this region in 1916 than in 1915. The quantity of miscellaneous lumber subjected to treatment was less by nearly 50%.

INTERIOR WESTERN REGION.

The plants of this region reported the smallest creosote consumption. The number of gallons used was 2,998,424, of which 1,093,620 were domestic and 1,904,804 imported. The former represents a decrease from the quantity reported in 1915 of 716,234 gals., while the latter shows a gain of 319,247 gals. Though this region ranked third in the quantity of zinc chloride consumed, the quantity reported was a little more than half of the consumption for 1915. In addition to the creosote and zinc chloride reported, there were used 2,002 gals. of miscellaneous preservatives.

The number of cross-ties treated by these plants was 3,301,265, or 700,613 less than the figure for 1915. A notable increase occurred in the quantity of piling treated in 1916, which amounted to 117,240 linear feet as compared with 3,010 linear feet for the year before. A corresponding increase was recorded in the number of poles treated, which in 1916 amounted to 11,441 as against 3,107 in 1915. Where 1,000 sq. yds. of paving blocks were run through the cylinders of the plants of this region in 1915, none were treated in 1916. Table 6 also shows an increase for this region in the quantity of construction timber treated, the figures for 1916 being 8,563,644 board feet as compared with 6,628,575 board feet for last year. Only 78 cross-arms were treated, while

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less than half the quantity of miscellaneous lumber shown by the 1915 figures was reported in 1916.

PACIFIC COAST REGION.

Eighteen plants were active in the Pacific Coast Region during the year. They consumed 2,070,743 gals. of domestic and 3,020,056 gals. of imported creosote, a combined consumption of 1,845,507 gals. more than was shown by the 1915 figures. These plants also used 2,253,516 lbs. of zinc chloride and 19,136 gals. of miscellaneous preservatives.

The number of cross-ties treated exceeded the number in 1915 by 358,198, while the quantity of piling reported shows an increase of 759,-521 linear feet. Over five times as many poles and more than six times as many paving blocks were reported in 1916 than in 1915. The quantity of construction timber subjected to treatment was less than for the year previous by 283,069 board feet, while the number of cross-arms reported was over 12 times as many. The amount of miscellaneous timber treated was less than for the year before by 84,409 board feet.

**Preservation of Ties.**

Since the wood-preserving industry in this country has been built very largely upon the treatment of railroad timber, principally ties, this class of material constitutes the bulk of the total quantity of wood treated. In 1916 there were reported a total of 150,522,982 cu. ft. of material subjected to preservative treatment, of which 112,408,104 cu. ft., or over 75%, were ties. The actual number of ties treated was 37,469,-368, an increase of 383,783 over the number recorded in 1915. Of this quantity 26,499,954 were sawed and 10,969,414 hewed.

Oak ties again lead in the number treated, constituting 44.9% of the total number reported. Yellow pine ties representing 28.1% ranked second, while Douglas fir ties came third with 8.1%. The number of ties of each kind of wood reported, the per cent. which each represents of the total, and the kind of preservative employed in their treatment, are shown in Table 7.

The number of ties treated with creosote was 20,858,801, and with zinc chloride 14,619,676. The number of ties treated with these two preservatives in the form of an emulsion was 1,978,414, while 12,477 were subjected to treatment with miscellaneous preservatives. In treating ties with creosote and refined water-gas-tar the average impregnation was 8.09 lbs. per cubic foot, while for zinc chloride it was 0.50 lb. per cubic foot. Where ties were treated with the emulsion the quantity of preservative forced into the wood averaged 2.75 lbs. of creosote and refined water-gas-tar and 0.48 lb. of zinc chloride. The Bethell,

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TABLE 7.—NUMBER OF CROSS-TIES TREATED IN UNITED STATES IN 1916.

| Preservative | Oak | Yellow pine | Douglas fir | Western pine | Beech | Gum | Tamarack | Maple | Birch | Elm | Other species | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Creosote | 8,176,923 | 8,549,861 | 783,583 | 671,557 | 1,326,890 | 80,285 | 432,414 | 280,189 | 138,791 | ..... | 418,308 | 20,858,801 |
| Zinc chloride | 7,349,883 | 1,615,900 | 2,223,803 | 1,012,605 | 261,911 | 57,494 | 931,755 | 121,286 | 61,300 | 47,309 | 936,430 | 14,619,676 |
| Zinc chloride and creosote | 1,305,309 | 343,021 | ..... | ..... | 88,683 | 10,720 | ..... | 60 | ..... | 3,709 | 226,912 | 1,978,414 |
| Miscellaneous | ..... | ..... | 12,477 | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 12,477 |
| Total | 16,832,115 | 10,508,782 | 3,019,863 | 1,684,162 | 1,677,484 | 148,499 | 1,364,169 | 401,535 | 200,091 | 51,018 | 1,581,650 | 37,469,368 |
| Per cent of total treated | 44.9 | 28.1 | 8.1 | 4.5 | 4.5 | 0.4 | 3.6 | 1.1 | 0.5 | 0.1 | 4.2 | 100.0 |

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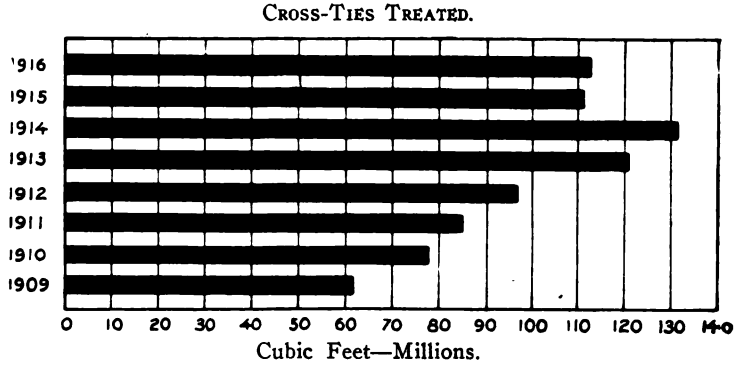


Boulton, Burnett, Card, Lowry, Rueping and open-tank processes were employed by the plants in the treatment of ties in 1916.

Table 8 shows comparatively the number of cross-ties purchased in 1915 by the principal classes of consumers and the quantity subjected to treatment during the same year.

TABLE 8.—CROSS-TIES PURCHASED AND TREATED IN 1915.

| Species | Number purchased | Number treated | Per cent treated of total purchased(a) |
|---|---|---|---|
| Oak | 49,333,881 | 16,885,517 | 34.22 |
| Yellow pine | 14,115,681 | 8,541,203 | 60.50 |
| Douglas fir | 6,950,910 | 3,553,854 | 51.12 |
| Beech | 1,173,490 | 2,933,737 | (a) |
| Western pine | 2,719,655 | 2,007,609 | 73.81 |
| Tamarack (b) | 3,858,098 | 932,038 | 24.15 |
| Gum | 485,466 | 277,886 | 57.24 |
| Birch | 465,815 | 173,971 | 37.39 |
| Maple | 1,069,547 | 36,942 | 3.45 |
| All other (c) | 16,934,108 | 1,742,828 | 10.28 |
| Total | 97,106,651 | 37,085,585 | 38.19 |

(a) Since railroads often purchase large quantities of ties in one calendar year which do not receive preservative treatment until one or more years following, it is impossible to harmonize the data showing ties purchased with that showing ties treated.

(b) Includes western larch.

(c) Includes elm, of which there were treated in 1915 a total of 50,846.

NOTE.—It was intended that these data be included in the 1915 statistics, but the compilations of ties purchased were not completed in time to incorporate them in last year's report. For this reason the number of ties treated and purchased in 1915 are shown in order to make the table entirely comparable.

## Preservation of Piles.

The quantity of piles treated in 1916 amounted to 12,690,867 linear feet, or 3,382,448 linear feet more than are shown by the figures for the

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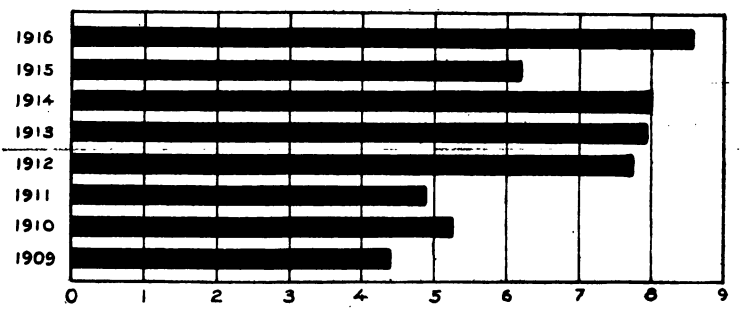
previous year. The principal species of wood represented are yellow pine and Douglas fir. The Southern Coast Region ranked first in the quantity treated with 5,539,949 linear feet, while next in importance was the quantity reported from the Atlantic Coast Region, amounting to 4,347,824 linear feet. The Pacific Coast Region was third with a total of 2,607,543 linear feet, while the combined quantities subjected to treatment in the plants of the Interior Eastern and Interior Western regions totaled 195,551 linear feet.

Bethell, Boiling, Burnett, Card, Lowry and Rueping were the processes used by the plants for the treatment of piles.* Where creosote was used the average injection amounted to 14.36 pounds per cubic foot, and with zinc chloride it was 0.43 pound per cubic foot.† With the use of the zinc-creosote emulsion the average amount of preservatives forced into the wood was 1.958 pounds of creosote and 0.43 pound of zinc chloride per cubic foot.

PILES TREATED.




Cubic Feet—Millions.

**Preservation of Poles.**

It is probable that as many more poles are subjected to some kind of preservative treatment as are reported by the treating plants. Such treatment, however, consists practically altogether of dipping or painting (brush treatment). Since this report includes only those poles which were treated in cylinders or open-tank plants, it does not cover material of the kind first referred to. The number of poles treated in 1916 was 328,517, or 202,461 more than were reported in 1915.

In the treatment of poles the Bethell, Burnett and Lowry and open-tank processes were used. Where straight creosote was employed the

*Though not reported, the Boulton process was probably used on the Pacific Coast.

†The injection shown for creosote is an average for piles for both land and water use. The average for the two classes separately would probably be from 7 to 14 pounds per cubic foot for the former and around 20 pounds for the latter.

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average injection of the preservative was 13.32 pounds per cubic foot, while for zinc chloride an average impregnation of 0.50 pound per cubic foot was obtained.

Table 9 shows the total number of poles purchased by the principal classes of consumers in 1915 arranged according to species and the total number treated. Since few of the treating plants indicate the kinds of wood represented in reporting the quantity of poles treated,

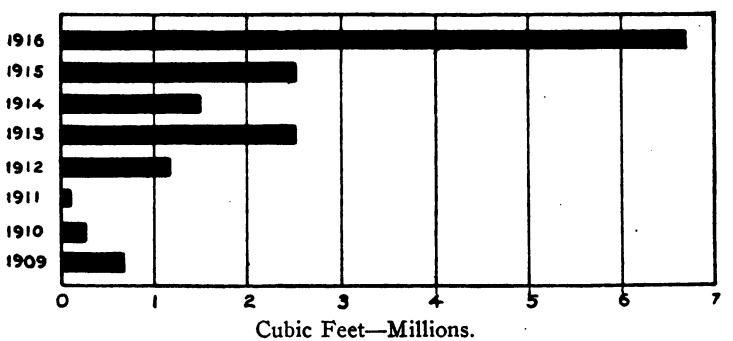
TABLE 9.—POLES PURCHASED IN 1915.

| Species | Number purchased |
|---|---|
| Northern white cedar | 1,747,210 |
| Chestnut | 651,643 |
| Western red cedar | 567,770 |
| Pine | 546,233 |
| White oak | 177,799 |
| Red cedar | 117,545 |
| Southern white cedar | 89,244 |
| Cypress | 67,644 |
| Red oak | 21,643 |
| All other | 91,233 |
| Total | 4,077,964 |
| Number treated | 125,639(a) |
| Per cent treated of total purchased | 3.1 |

(a) Includes 90,766 cedar poles treated by open-tank process and 198,116 southern yellow pine poles treated by Bethell or Lowry processes.

the only figures which can be taken as a basis for comparison are the totals shown for the number purchased and the number treated, together with the per cent.

POLES TREATED.




**Preservation of Paving Blocks.**

The quantity of paving material treated in 1916 shows an increase over the 1915 figures of 852,171 sq. yds. The total for the year was 3,788,541 sq. yds. The percentage of increase was greatest in the Pa-

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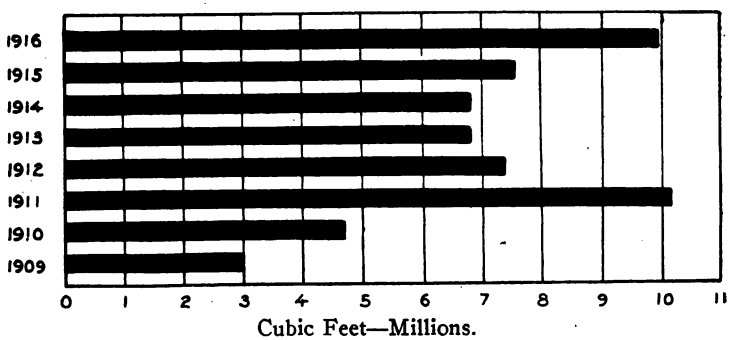
cific Coast Region, where 414,884 sq. yds. were treated during 1916 as compared with 66,552 in 1915. The Interior Eastern and Southern Coast regions also contributed to the increase with 317,572 and 334,095 sq. yds., respectively. Where 1,000 sq. yds. were reported by the Interior Western Region in 1915, none was treated in that region this year.

Yellow pine blocks were first in importance, the quantity treated being nearly six times the total number of all other species combined. Douglas fir blocks ranked second with a total of 409,569 sq. yds. treated, followed by 220,955 sq. yds. for tamarack, 6,849 sq. yds. of Norway pine, 6,098 sq. yds. of western larch and 4,400 sq. yds. of sugar maple, the latter wood never having been reported before.

All but about 1,000 sq. yds. of the total quantity reported were treated with creosote, refined water-gas-tar, paving oil or a mixture of these preservatives, the average impregnation being 13.83 lbs. per cubic foot. The remainder were treated with 0.53 lb. of zinc chloride per cubic foot.

The Bethell, Boiling, Burnett, Lowry and Rueping processes were employed.

PAVING BLOCKS TREATED.




**Preservation of Construction Timber.**

The material included under this heading consists principally of bridge timber, switch-ties and other heavy structural material. The total amount of material of this class which was impregnated with preservatives in 1916 by the treating plants of this country was 138,889,-222 board feet, a decrease from the quantity reported in 1915 of 3,119,-819 board feet.

As was the case in 1915, the Southern Coast Region reported the largest amount of construction timber treated, the quantity being 69,-

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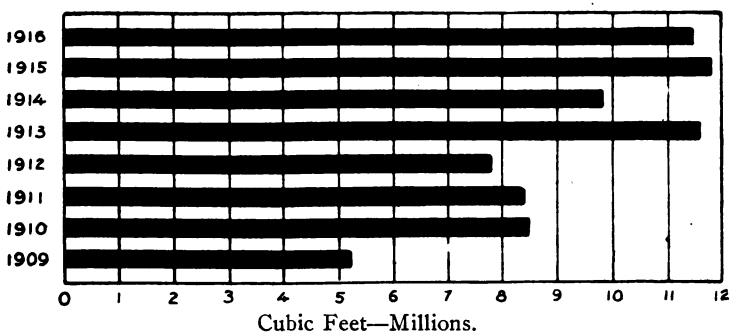
260,630 board feet, or nearly 50% of the total quantity shown. The Atlantic Coast Region took second place with 30,108,195 board feet.

Yellow pine constituted the major portion of the material treated, except in the Pacific Coast Region, where it consisted entirely of Douglas fir.

The average quantity of creosote forced into the wood was 11.65 pounds per cubic foot, while for zinc chloride it amounted to 0.45 pound per cubic foot. Some plants used these two preservatives in combination, and secured an average absorption per cubic foot of 2.40 pounds of creosote and refined water-gas-tar and 0.498 pound of zinc chloride.

Practically all treating processes were used, including the Bethell, Boiling, Boulton, Burnett, Card, Lowry, Rueping and open-tank.

CONSTRUCTION TIMBER TREATED.




Cubic Feet—Millions.

**Preservation of Cross-Arms.**

The largest quantity of this class of material was treated by the plants of the Southern Coast Region, the number reported being 197,103, or an increase of 75,158 over the number treated in 1915. A marked increase occurred in the number of cross-arms treated in the Pacific Coast Region, where 64,267 were run through the cylinders in 1916, or more than 12 times the number reported in the year previous. The total number reported by all plants was 291,778.

Creosote with an average injection of 10.73 pounds per cubic foot was the only preservative used, and the processes employed were the Bethell, Rueping and open-tank.

**Preservation of Miscellaneous Lumber.**

The material included under this heading consists of mine props, tunnel sets, dowels, tie plugs, drain boxes, shingles, pipe staves, signboard lumber, fence posts, factory sub-flooring, conduits, trunking and

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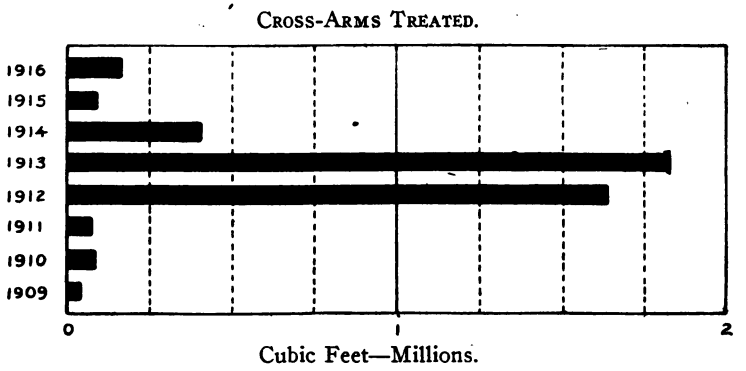


capping, cattle guards, dead men, pole steps and miscellaneous lumber and planking. The total amount of this class of material reported was 13,024,000 board feet, or 913,509 board feet less than was treated in 1915.

Three kinds of preservatives were used in the treatment of the quantity reported, namely, creosote, zinc chloride and sodium fluoride. For the first mentioned the average absorption was 10.69 pounds per cubic foot, for the second 0.50 pound per cubic foot, and for the third, which makes its first appearance in these statistics, the quantity was 0.33 pound per cubic foot.

The Bethell, Boulton, Burnett, Lowry and Rueping and open-tank processes were used.

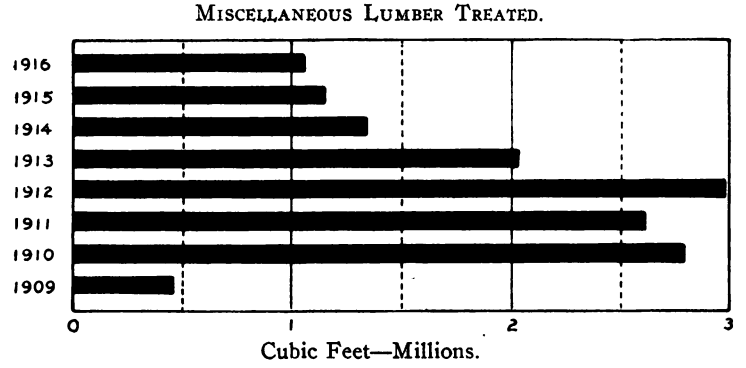


Table 10 gives a summary in cubic feet of the total amount of material treated in each class from 1909 to 1916. It also shows the amount of material treated for these years with the various preservatives employed. Formerly the quantity of each class of material treated with

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miscellaneous preservatives was included in the grand totals. In this table, however, these items are shown separately..

TOTAL MATERIAL TREATED.

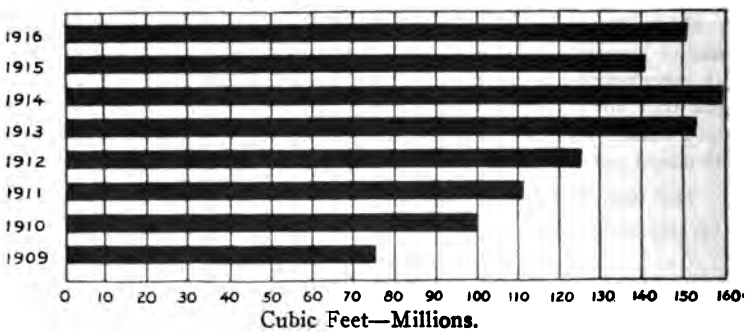


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TABLE 10.—MATERIAL TREATED IN THE UNITED STATES, 1909 TO 1916.

| Preservatives | Year | Cross-ties | Piles | Poles | Paving blocks | Cross-arms | Construction timber | Miscellaneous lumber | Total material treated |
|---|---|---|---|---|---|---|---|---|---|
| | | *Cu. ft.* | *Cu. ft.* | *Cu. ft.* | *Cu. ft.* | *Cu. ft.* | *Cu. ft.* | *Cu. ft.* | *Cu. ft.* |
| Creosote | 1909 | 29,830,080 | 4,421,726 | 659,664 | 2,994,290 | 41,764 | 4,902,311 | 417,787 | 43,267,622 |
| | 1910 | 44,525,229 | 5,219,254 | 255,597 | 4,692,453 | 88,069 | 7,801,272 | 2,687,713 | 65,269,587 |
| | 1911 | 49,532,163 | 4,937,363 | 106,213 | 10,145,724 | 71,961 | 7,417,105 | 2,499,995 | 74,710,524 |
| | 1912 | 57,461,515 | 7,624,939 | 1,169,981 | 7,091,658 | 1,643,128 | 6,892,493 | 2,841,195 | 84,724,909 |
| | 1913 | 75,998,307 | 7,630,328 | 2,367,769 | 6,810,308 | 1,813,010 | 10,308,883 | 1,853,993 | 106,782,598 |
| | 1914 | 67,774,329 | 7,804,657 | 1,188,511 | 3,127,506 | 395,403 | 8,389,158 | 1,348,566 | 90,028,130 |
| | 1915 | 51,231,207 | 6,288,238 | 2,336,318 | 6,064,758 | 87,373 | 9,264,164 | 881,028 | 76,153,086 |
| | 1916 | 62,576,403 | 8,524,680 | 6,303,954 | 7,205,953 | 178,210 | 9,521,609 | 691,870 | 95,002,679 |
| Zinc chloride | 1909 | 24,153,162 | (a) | (a) | (a) | (a) | 320,891 | 2,333 | 24,476,386 |
| | 1910 | 27,587,583 | (a) | (a) | (a) | (a) | 541,514 | 71,060 | 28,200,157 |
| | 1911 | 28,337,883 | (a) | (a) | (a) | (a) | 1,043,851 | 119,931 | 29,501,665 |
| | 1912 | 28,532,874 | (a) | 18,246 | (a) | (a) | 259,972 | 20,092 | 28,831,184 |
| | 1913 | 36,051,816 | (a) | 47,996 | (a) | (a) | 585,756 | 7,670 | 36,693,238 |
| | 1914 | 50,020,755 | (a) | (b) | (a) | (a) | 1,317,925 | 4,355 | 51,343,035 |
| | 1915 | 53,457,852 | 4,726 | (a) | (a) | (a) | 2,406,150 | 275,279 | 56,144,007 |
| | 1916 | 43,859,028 | 859 | 164 | (a) | (a) | 1,526,881 | 346,047 | 45,732,979 |
| Zinc-creosote | 1909 | 8,095,794 | (a) | (a) | (a) | (a) | 62,918 | 43,699 | 8,202,411 |
| | 1910 | 6,354,219 | 38,392 | (a) | (a) | (a) | 181,143 | 30,646 | 6,604,400 |
| | 1911 | 7,312,374 | (b) | (a) | (a) | (a) | (b) | (b) | 7,312,374 |
| | 1912 | 8,214,303 | 97,874 | (a) | (a) | (a) | 560,613 | 99,367 | 8,972,157 |
| | 1913 | 6,938,838 | 327,594 | (a) | (b) | (a) | 758,989 | 53,628 | 8,079,049 |
| | 1914 | 5,868,834 | (a) | (a) | (b) | (a) | 140,718 | (b) | 6,009,552 |
| | 1915 | 6,548,136 | 2,320 | 110,220 | (a) | (a) | 40,396 | 4,822 | 6,705,894 |
| | 1916 | 5,935,242 | 837 | 53,933 | (a) | (a) | 359,428 | (a) | 6,349,440 |
| Miscellaneous | 1909 | (a) | (a) | (a) | (a) | (a) | (a) | (a) | (a) |
| | 1910 | (a) | (a) | (a) | (a) | (a) | (a) | (a) | (a) |
| | 1911 | (a) | (a) | (a) | (a) | (a) | (a) | (a) | (a) |
| | 1912 | 2,974,317 | 14,222 | 352 | 305,437 | (a) | 80,446 | 28,032 | 3,402,806 |
| | 1913 | 1,792,287 | (a) | 84,655 | 45,985 | 11,709 | (a) | 124,367 | 2,059,003 |
| | 1914 | 7,877,043 | 257,245 | 293,896 | 3,741,864 | 22,511 | (a) | 9,363 | 12,201,922 |
| | 1915 | 19,560 | (a) | 66,242 | 1,643,213 | 3,254 | 123,377 | 330 | 1,855,976 |
| | 1916 | 37,431 | 56,458 | 389,031 | 2,738,731 | 2,634 | 166,183 | 47,416 | 3,437,884 |
| All preservatives | 1909 | 62,079,036 | 4,421,726 | 659,664 | 2,994,290 | 41,764 | 5,286,120 | 463,819 | 75,946,419 |
| | 1910 | 78,467,031 | 5,257,646 | 255,597 | 4,692,453 | 88,069 | 8,523,929 | 2,789,419 | 100,074,144 |
| | 1911 | 85,182,420 | 4,937,363 | 106,213 | 10,145,724 | 71,961 | 8,460,956 | 2,619,926 | 111,524,563 |
| | 1912 | 97,183,009 | 7,737,035 | 1,188,579 | 7,397,095 | 1,643,128 | 7,793,524 | 2,988,686 | 125,931,056 |
| | 1913 | 120,781,248 | 7,957,922 | 2,500,420 | 6,856,293 | 1,824,719 | 11,653,628 | 2,039,658 | 153,613,888 |
| | 1914 | 131,540,961 | 8,061,902 | 1,482,407 | 6,869,370 | 417,914 | 9,847,801 | 1,362,284 | 159,582,639 |
| | 1915 | 111,256,755 | 6,295,284 | 2,512,780 | 7,707,971 | 90,627 | 11,834,087 | 1,161,459 | 140,858,963 |
| | 1916 | 112,408,104 | 8,582,834 | 6,747,082 | 9,944,684 | 180,844 | 11,574,101 | 1,085,333 | 150,522,982 |

(a) No statistics; (b) Figures if used would reveal identity of reporting firms.

CONVERTING FACTORS.—To obtain the number of cross-ties, divide by 3; linear feet of piling, divide by 0.6763; poles, divide by 0.5868; square yards of paving blocks, divide by 2.625; cross-arms, divide by 0.6198; board feet of construction timber, multiply by 12; board feet of lumber and miscellaneous material, multiply by 12.

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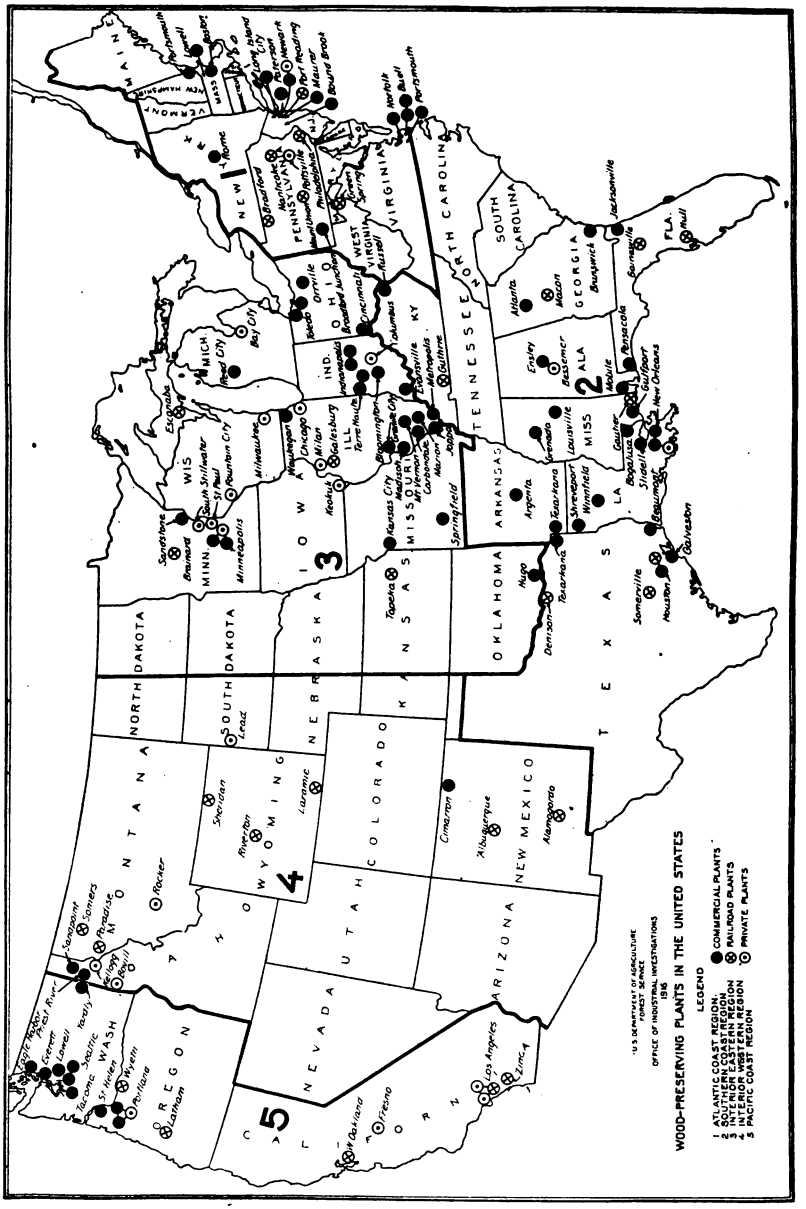


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## MILEAGE OF STEAM, HORSE AND ELECTRIC RAILWAYS IN THE UNITED STATES.

### Cross-Ties Used and Treated—Treating Plants in Operation.

| Year | Steam Railroads | | Horse & Elec. Rwys. | Total | Ties used | Ties treated | | Treating plants in operation |
|---|---|---|---|---|---|---|---|---|
| | First main tracks | Other tracks | | | | | | |
| | *Miles* | *Miles* | *Miles* | *Miles* | *Number* | *Number* | *Per Cent.* | *Number* |
| 1860 | 30,626 | 3,000 | 200 | 33,826 | 10,147,800 | From 1860 to | | |
| 1870 | 52,922 | 9,100 | 1,200 | 63,222 | 18,966,600 | 1885 inclusive | 0.10 | 3 |
| 1880 | 93,267 | 21,977 | 2,000 | 117,244 | 35,173,200 | Approx. 50,000 | | |
| 1885 | 123,320 | 32,868 | 2,800 | 158,988 | 47,696,400 | 120,000 | 0.25 | 5 |
| 1886 | 125,185 | 34,441 | 3,120 | 162,746 | 48,823,800 | 510,000 | 1.04 | 5 |
| 1887 | 137,028 | 37,348 | 3,680 | 178,056 | 53,416,800 | 594,000 | 1.11 | 5 |
| 1888 | 145,387 | 38,221 | 4,112 | 187,720 | 56,316,000 | 644,000 | 1.14 | 6 |
| 1889 | 153,725 | 42,242 | 4,930 | 200,897 | 60,269,100 | 615,000 | 1.02 | 7 |
| 1890 | 163,597 | 42,036 | 5,241 | 213,874 | 64,168,200 | 650,000 | 1.01 | 8 |
| 1891 | 168,403 | 47,746 | 6,155 | 222,304 | 66,691,200 | 697,000 | 1.05 | 8 |
| 1892 | 171,564 | 50,787 | 7,040 | 229,391 | 68,817,300 | 790,000 | 1.15 | 9 |
| 1893 | 176,461 | 53,676 | 8,870 | 239,007 | 71,702,100 | 812,000 | 1.13 | 10 |
| 1894 | 178,709 | 54,825 | 8,949 | 242,483 | 72,744,900 | 920,000 | 1.26 | 11 |
| 1895 | 180,657 | 56,237 | 10,810 | 247,704 | 74,311,200 | 1,289,000 | 1.73 | 12 |
| 1896 | 182,777 | 57,352 | 12,133 | 252,262 | 75,678,600 | 1,307,000 | 1.73 | 13 |
| 1897 | 183,284 | 58,729 | 13,756 | 255,778 | 76,733,400 | 1,312,000 | 1.71 | 13 |
| 1898 | 184,648 | 60,686 | 15,942 | 261,276 | 78,382,800 | 1,826,000 | 2.33 | 13 |
| 1899 | 187,535 | 62,608 | 17,665 | 267,808 | 80,342,400 | 2,510,000 | 3.12 | 15 |
| 1900 | 192,556 | 66,228 | 19,314 | 278,098 | 83,429,400 | 2,800,000 | 3.36 | 15 |
| 1901 | 195,562 | 69,790 | 22,217 | 287,569 | 86,270,700 | 4,101,000 | 4.75 | 17 |
| 1902 | 200,155 | 74,041 | 25,592 | 299,788 | 89,936,400 | 6,180,000 | 6.87 | 22 |
| 1903 | 205,314 | 78,508 | 27,754 | 311,576 | 93,472,800 | 9,010,000 | 9.64 | 27 |
| 1904 | 212,243 | 84,830 | 29,548 | 326,621 | 97,986,300 | 12,800,000 | 13.06 | 30 |
| 1905 | 216,974 | 89,823 | 32,517 | 339,314 | 77,982,000 | 14,890,000 | 19.09 | 34 |
| 1906 | 222,340 | 94,643 | 36,212 | 353,195 | 102,834,000 | 16,880,000 | 16.41 | 39 |
| 1907 | 227,455 | 100,520 | 38,812 | 366,787 | 153,700,000 | 19,856,000 | 12.92 | 51 |
| 1908 | 229,203 | 103,152 | 40,247 | 372,602 | 111,780,600 | 23,776,000 | 21.27 | 57 |
| 1909 | 234,059 | 106,950 | 40,490 | 381,499 | 114,449,700 | 22,033,000 | 19.25 | 68 |
| 1910 | 239,447 | 110,936 | 40,088 | 390,471 | 117,141,300 | 30,544,000 | 26.08 | 78 |
| 1911 | 244,476 | 116,586 | 41,088 | 402,150 | 120,645,000 | 31,141,000 | 58.81 | 81 |
| 1912 | 247,981 | 121,386 | 42,110 | 411,477 | 123,443,100 | 32,394,000 | 26.24 | 87 |
| 1913 | 250,534 | 126,038 | 43,043 | 419,615 | 125,884,500 | 40,260,000 | 32.00 | 92 |
| 1914 | 253,997 | 130,656 | 43,989 | 428,642 | 147,592,600 | 43,847,000 | 34.37 | 95 |
| 1915 | 257,569 | 133,573 | 46,613 | 437,755 | 131,326,500 | 37,085,585 | 28.24 | 102 |
| 1916 | 260,144 | 136,700 | 47,721 | 444,565 | 133,369,500 | 37,469,368 | 28.10 | 117 |

Mileage of steam railroads from 1890 to 1914 from records of Interstate Commerce Commission.
Cross-ties used and treated from 1906 to 1911 from Census Reports.
Cross-ties used from 1860 to 1905 and from 1912 to 1916 estimated on basis of 300 ties per mile.

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## WOOD-PRESERVING PLANTS IN UNITED STATES, CANADA AND MEXICO.

### UNITED STATES.

### PRESSURE PROCESSES.

| Managing Company | Headquarters | Location of Plant | Year Built | Retorts: Number | Retorts: Diameter Inches | Retorts: Length Feet |
|---|---|---|---|---|---|---|
| American Creosoting Co. | New York, N. Y. | Newark, N. J. | 1906 | 1 | 78 | 105 |
| " " " | | | | 1 | 78 | 165 |
| " " " | Louisville, Ky. | Indianapolis, Ind. | 1913 | 2 | 64 | 134 |
| " " " | " " | Marion, Ill. | 1907 | 2 | 84 | 134 |
| " " " | " " | Springfield, Mo. | 1907 | 2 | 84 | 134 |
| " " " | " " | Kansas City, Mo. | 1907 | 2 | 84 | 134 |
| " " " | " " | Russell, Ky. | 1915 | 1 | 84 | 134 |
| " " " | " " | Hugo, Okla. | 1907 | 2 | 84 | 134 |
| American Creosote Works. | New Orleans, La. | Southport, nr. New Orleans | 1901 | 1 | 84 | 172 |
| " " " | " " " | Louisville, Miss. | 1912 | 1 | 108 | 172 |
| Anaconda Copper Mining Co. | Butte, Mont. | Rocker, Mont. | 1910 | 1 | 72 | 43 |
| A. T. & S. F. Rwy. Co. | Topeka, Kan. | Albuquerque, N. M. | 1908 | 2 | 74 | 132 |
| Atlantic Coast Line R. R. Co. | Wilmington, N. C. | Gainesville, Fla. | 1912 | 2 | 74 | 138 |
| Atlantic Creo. & W. P. Wks. | Norfolk, Va. | Norfolk, Va. | 1901 | 1 | 78 | 62 |
| | | | | 1 | 78 | 82 |
| | | | | 1 | 78 | 126 |
| Ayer & Lord Tie Co. | Chicago, Ill. | Grenada, Miss. | 1904 | 4 | 74 | 128 |
| " " " " | " " | Argenta, Ark. | 1907 | 4 | 74 | 132 |
| " " " " | " " | Carbondale, Ill. | 1902 | 4 | 72 | 122 |
| | | | | 4 | 74 | 132 |
| Baltimore & Ohio R. R. Co. | Baltimore, Md. | Green Spring, W. Va. | 1912 | 2 | 84 | 132 |
| Barber Asphalt Paving Co. | Maurer, N. J. | Maurer, N. J. | 1905 | 4 | 72 | 115 |
| Boston Elevated Rwy. Co. | Boston, Mass. | South Boston, Mass. | 1916 | 1 | 90 | 51 |
| Buffalo, Rochester & Pitsburgh R. R. Co. | Rochester, N. Y. | Bradford, Pa. | 1910 | 1 | 75 | 95 |
| Bunker Hill & Sullivan Mg. Co. | Kellogg, Idaho | Kellogg, Idaho | 1908 | 1 | 84 | 10 |
| Carbolineum Wood Pres. Co. | Portland, Ore. | Portland, Ore. | 1901 | 1 | .. | .... |
| Central Creosoting Co. | Chicago, Ill. | Waukegan, Ill. | 1907 | 2 | 72 | 134 |
| " " " | " " | Terre Haute, Ind. | 1912 | 2 | 132 | 20 |
| Central of Ga. R. R. Co. | Macon, Ga. | Macon, Ga. | 1912 | 2 | 84 | 116 |
| Central R. R. of New Jersey. | Port Reading, N. J. | Port Reading, N. J. | 1912 | 2 | 88 | 140 |
| Charlotte Harbor & No. Ry. Co. | Boca Grande, Fla. | Hull, Fla. | 1912 | 1 | 74 | 73 |
| C. B. & Q. R. R. Co. | Chicago, Ill. | Galesburg, Ill. | 1907 | 5 | 74 | 132 |
| " " | " " | Sheridan, Wyo. | 1899 | 2 | 74 | 132 |
| Chicago & N. W. Ry. Co. | " " | Escanaba, Mich. | 1903 | 3 | 72 | 112 |
| " " " | " " | Riverton, Wyo. | 1915 | 1 | 72 | 110 |
| Colman Co., J. M. | Seattle, Wash. | West Seattle, Wash. | 1884 | 3 | 75 | 120 |
| Colonial Creosoting Co. | Louisville, Ky. | Bogalusa, La. | 1912 | 2 | 72 | 134 |
| Columbia Creosoting Co. | Portland, Oregon | Linnton, nr. P'tland, Ore. | 1912 | 1 | 72 | 132 |
| | | | | 1 | 72 | 65 |
| Compressed Wood Preserving Co. | Cincinnati, O. | Cincinnati, O. | 1909 | 2 | 72 | 76 |
| Continental Tie & Lbr. Co. | Denver, Colo. | Cimarron, N. M. | 1913 | 1 | 84 | 87 |
| El Paso & S. W. R. R. Co. | El Paso, Tex. | Alamogordo, N. M. | 1902 | 2 | 72 | 106 |
| Eppinger & Russell Co. | New York, N. Y. | Long Island City, N. Y. | 1878 | 4 | 72 | 100 |
| " " " " | " " " | Jacksonville, Fla. | 1909 | 3 | 84 | 130 |

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## Wood-Preserving Plants in United States.—(Continued)

| Managing Company | Headquarters | Location of Plant | Year Built | Retorts: Number | Retorts: Diameter Inches | Retorts: Length Feet |
|---|---|---|---|---|---|---|
| Federal Creosoting Co. | Louisville, Ky. | Bound Brook, N. J. | 1909 | 1 | 84 | 150 |
| " " " | " " | Toledo, O. | 1909 | 3 | 84 | 134 |
| " " " | " " | Rome, N. Y. | 1910 | 2 | 84 | 150 |
| " " " | " " | Paterson, N. J. | 1909 | 1 | 84 | 150 |
| Georgia Creosoting Co. | Louisville, Ky. | Brunswick, Ga. | 1915 | 2 | 84 | 121 |
| Great Northern Ry. Co. | St. Paul, Minn. | Somers, Mont. | 1901 | 4 | 72 | 110 |
| Gulfport Creosoting Co. | Gulfport, Miss. | Gulfport, Miss. | 1906 | 2 | 84 | 120 |
| Indiana Creosoting Co. | Louisville, Ky. | Bloomington, Ind. | 1907 | 1 | 84 | 134 |
| Indiana Tie Co. | Evansville, Ind. | Evansville, Ind. | 1907 | 2 | 72 | 110 |
| " " " | Evansville, Ind. | Joppa, Ill. | 1909 | 2 | 72 | 110 |
| Indiana Zinc Creosoting Co. | Terre Haute, Ind. | Terre Haute, Ind. | 1904 | 2 | 72 | 120 |
| Interstate Public Service Co. | Indianapolis, Ind. | Columbus, Ind. | 1909 | 1 | 72 | 45 |
| Int'l. Creo. & Con. Co. | Galveston, Tex. | **Beaumont, Tex.** | 1892<br>1897 | 1 | 108 | 140 |
| " " " " | " " | Galveston, Tex. | 1905 | 1 | 72 | 100 |
| " " " " | " " | Texarkana, Ark. | 1902 | 1<br>1 | 114<br>72 | 165<br>125 |
| Jennison-Wright Co. | Toledo, O. | Toledo, O. | 1910 | 2 | 72 | 130 |
| Kettle River Co. | Minneapolis, Minn. | Madison, Ill. | 1909 | 4 | 84 | 135 |
| " " " | " " | Sandstone, Minn. | 1904 | 2 | 72 | 120 |
| Louisiana Creosoting Co. | Winnfield, La. | Winnfield, La. | 1906 | 1<br>1 | 72<br>72 | 126<br>80 |
| L. & N. R. R. Co. | Louisville, Ky. | Guthrie, Ky. | 1913 | 2 | 84 | 133 |
| " " " " " " | " " | Gautier, Miss. | 1895<br>1916 | 1<br>1<br>1 | 72<br>72<br>84 | 115<br>133<br>133 |
| Los Angeles & S. L. R. R. Co. | Los Angeles, Cal. | Zinc, Cal. | 1908 | 2 | 72 | 117 |
| Michigan Pipe Co. | Bay City, Mich. | Bay City, Mich. | 1893 | 1 | 72 | 42 |
| Michigan Wood Preserving Co. | Pittsburgh, Pa. | Reed City, Mich. | 1913 | 1 | 90 | 90 |
| Midland Creosoting Co. | Toledo, O. | Granite City, Ill. | 1917 | 2 | 74 | 140 |
| Mo., Kan & Tex. Ry. Co. | St. Louis, Mo. | Dennison, Tex. | 1909 | 4 | 72 | 108 |
| Moss Tie Co., T. J. | " " " | Mt. Vernon, Ill. | 1899 | 1<br>1 | 74<br>72 | 132<br>117 |
| Nat'l Lbr. & Creo. Co. | Texarkana, Ark. | Texarkana, Tex. | 1910 | 2 | 84 | 132 |
| " " " " | " " | Houston, Tex. | 1912 | 4 | 72 | 120 |
| Norfolk Creosoting Co. | Norfolk, Va. | **Buell (nr. Norfolk), Va.** | 1896<br>1905 | 4<br>1<br>1 | 78<br>78<br>84 | 100<br>105<br>125 |
| Northern Pacific Ry. Co. | St. Paul, Minn. | Brainerd, Minn. | 1907 | 2 | 84 | 134 |
| " " " " | " " | Paradise, Mont. | 1907 | 2 | 84 | 133 |
| Ohio Wood Preserving Co. | Pittsburgh, Pa. | Orrville, O. | 1912 | 1 | 84 | 90 |
| Oregon-Wash. R. R. & Nav. Co. | Portland, Oregon | Wyeth, Oregon | 1904 | 4 | 72 | 114 |
| Pacific Creosoting Co. | Seattle, Wash. | Eagle Harbor, Wash. | 1906 | 8 | 73 | 125 |
| Pennsylvania R. R. Co. | Philadelphia, Pa. | Mount Union, Pa. | 1909 | 1 | 72 | 132 |
| " " " | " " | Greenwich, Phila, Pa. | 1910 | 2 | 72 | 132 |

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## Wood-Preserving Plants in United States.—(Concluded)

| Managing Company | Headquarters | Location of Plant | Year Built | Retorts: Number | Retorts: Diameter Inches | Retorts: Length Feet |
|---|---|---|---|---|---|---|
| Phila. & Reading Ry. | Port Reading, N. J. | Port Reading, N. J. | 1912 | 2 | 88 | 140 |
| Pioneer Lbr. & Creo. Co. | Ensley, Ala. | Ensley, Ala. | 1911 | 1 | 74 | 76 |
| Pittsburgh Wood Preserving Co. | Pittsburgh, Pa. | Adelaide, Pa. | 1911 | 1 | 84 | 90 |
| Puget Sound Wd. Pres. Co. | Lowell, Wash. | Lowell, Wash. | 1895 | 1 | 84 | 117 |
| | | | | 1 | 72 | 83 |
| | | | | 1 | 72 | 52 |
| Republic Creosoting Co. | Indianapolis, Ind. | Mobile, Ala. | 1906 | 2 | 74 | 130 |
| " " " | " " | Indianapolis, Ind. | 1903 | 1 | 74 | 130 |
| " " " | " " | Seattle, Wash. | 1916 | 1 | 74 | 130 |
| " " " | Minneapolis. Minn. | Minneapolis, Minn. | 1905 | 2 | 74 | 130 |
| St. Helens Creosoting Co. | Portland, Oregon | St. Helens, Oregon | 1912 | 4 | 84 | 136 |
| St. Paul & Tacoma Lbr. Co. | Tacoma, Wash. | Tacoma, Wash. | 1912 | 1 | 84 | 130 |
| Santa Fe Tie & Lumber Preserving Co. | Topeka, Kan. | Somerville, Tex. | 1906 | 5 | 74 | 132 |
| Shreveport Creosoting Co. | Louisville, Ky. | Shreveport, La. | 1910 | 2 | 84 | 134 |
| Southern Creosoting Co. | Slidell, La. | Slidell, La. | 1879 | 1 | 84 | 150 |
| | | | 1902 | 2 | 72 | 100 |
| Southern Pacific Co. | San Francisco, Cal. | Latham, Oregon | 1893 | 2 | 72 | 117 |
| " " " | " " " | West Oakland, Cal. | 1887 | 1 | 72 | 108 |
| | | | | 1 | 72 | 138 |
| " " " | " " " | Los Angeles, Cal. | 1907 | 2 | 72 | 112 |
| Southern Paving & Const. Co. | Chattanooga, Tenn. | Pensacola, Fla. | 1912 | 1 | 72 | 90 |
| Southern Wood Pres. Co. | Atlanta, Ga. | Atlanta, Ga. | 1908 | 1 | 72 | 100 |
| Tenn. C. I. & R. R. Co. | Birmingham, Ala. | Bessemer, Ala. | 1909 | 1 | 72 | 65 |
| Texas & N. O. R. R. Co. | Houston, Tex. | Houston, Tex. | 1890 | 5 | 72 | 112 |
| Union Pacific R. R. Co. | Omaha, Neb. | Topeka, Kan. | 1909 | 2 | 73 | 117 |
| " " " | " " | Laramie, Wyo. | 1903 | 2 | 73 | 117 |
| U. S. Gov't Wood Pres. Plant | New Orleans, La. | New Orleans, La. | | | | |
| U. S. Wood Preserving Co. | New York, N. Y. | Buell (near Norfolk), Va. | 1907 | 2 | 78 | 150 |
| Western Wood Pres. Co. | Spokane, Wash. | Yardley, Wash. | 1912 | 1 | 84 | 65 |
| Wyckoff Pipe & Creo. Co. | New York, N. Y. | Portsmouth, Va. | 1881 | 4 | 74 | 102 |
| Watkins Creosoting Co. | Chicago, Ill. | Metropolis, Ill. | 1913 | 1 | 74 | 100 |
| **CANADA.** | | | | | | |
| Bruce & Co., Alex. | Glasgow, Scotland | Fort Francis, Ont. | 1912 | 1 | 84 | 76 |
| Canada Creosoting Co., Ltd. | Toronto, Ont. | Trenton, Ont. | 1913 | 1 | 84 | 134 |
| Dominion Creo. Co., Ltd. | Vancouver, B. C. | Vancouver, B. C. | 1910 | 2 | 90 | 100 |
| Dominion Tar & Chem. Co. | Sydney, N. S. | Sydney, N. S. | 1911 | 1 | 78 | 85 |
| " " " " | " " | Transcona (nr. Winnipeg), Manitoba | 1912 | 1 | 78 | 84 |
| | | | | 3 | 78 | 135 |
| Vancouver Creosoting Co., Ltd. | Vancouver, B. C. | North Vancouver, B. C. | 1916 | 2 | 84 | 132 |

**MEXICO.**

No data available regarding treating plants in Mexico. The Mexican Central Railroad built a plant at Aguas Calientas, Mex., in 1901, to treat railroad ties with zinc chloride. About the year 1907 the Madero Co. built a 2-retort plant at Madera, Chihuahua, Mex., to treat railroad ties with zinc chloride.

Corrected to May 1, 1917.

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## WOOD-PRESERVING PLANTS IN UNITED STATES, CANADA AND MEXICO.

### UNITED STATES.

NON-PRESSURE PROCESSES.

| Managing Company | Headquarters | Location of Plant | Year Built | Tanks or Cylinders: Number | Tanks or Cylinders: Size Feet |
|---|---|---|---|---|---|
| Allen & Son Co., Otis | Lowell, Mass. | Lowell, Mass. | 1848 | 2 | 4x 8x50 |
| " " " " " | " " | Portsmouth, N. H. | 1875 | 4 | 4x 8x50 |
| Anaconda Copper Mg. Co. | Butte, Mont. | Rocker, Mont. | 1909 | 1 | 10x10x10 |
| Barnes-Lindsley Mfg. Co. | Portland, Oregon | Portland, Oregon | .... | . | ..... |
| Baxter & Jordan | Los Angeles, Cal. | Los Angeles, Cal. | 1911 | . | ..... |
| Carbolineum Wd. Pres. Co. | Portland, Oregon. | Portland, Oregon | 1910 | 4 | 3x 4x60 |
| E. T. Chapin Co. | Spokane, Wash. | Bovil, Idaho | 1915 | 2 | 8x12x11 |
| Del. Lack. & West. R. R. Co. | Scranton, Pa. | Nanticoke, Pa. | 1907 | 1 | 6 dia. x32 |
| Homestake Mining Co. | Lead, S. D. | Lead, S. D. | 1908 | 1 | 4 dia. x38 |
| Lindsley Bros. Co. | Spokane, Wash. | Minneapolis, Minn. | 1916 | 2 | 14x18x11 |
| " " " | " " | Priest River, Idaho | 1910 | 2 | 5 dia. x11 |
| Milwaukee Ry. & Light Co. | Milwaukee, Wis. | Milwaukee, Wis. | 1910 | . | ..... |
| Naugle Pole & Tie Co. | Chicago, Ill. | Chicago, Ill. | 1912 | 2 | 5x 5x10 |
| Pacific Light & Power Co. | Los Angeles, Cal. | Los Angeles, Cal. | 1912 | 3 | 10.5x8.5x9 |
| Page & Hill Co. | Minneapolis, Minn. | Minneapolis, Minn. | 1911 | 4 | 6 dia. x11 |
| P. & R. Coal & Iron Co. | Pottsville, Pa. | New Philadelphia, Pa. | 1908 | 1 | 6 dia. x32 |
| Portland Ry. Light & Power Co. | Portland, Ore. | Portland, Ore. | | | |
| Public Service Electric Co. | Newark, N. J. | Newark, N. J. | 1909 | 1 | 10x32x 2 |
| Puget Sound Wd. P. Co. | Lowell, Wash. | Lowell, Wash. | 1895 | 1 | 3x10x30 |
| Reeves Co., The | New Orleans, La. | New Orleans, La. | 1915 | 1 | 3x 3x30 |
| | | | 1910 | 1 | 4x 4x30 |
| Republic Creosoting Co. | Mobile, Ala. | Mobile, Ala. | 1912 | 1 | 3x19x10 |
| San Joaquin L. & P. Co. | Fresno, Cal. | Fresno, Cal. | 1910 | 2 | 7x 9x 9 |
| St. Paul & Tacoma Lbr. Co. | Tacoma, Wash. | Tacoma, Wash. | 1915 | 4 | 7x10x30 |
| Southern Pacific Co. | San Francisco, Cal. | West Oakland, Cal. | 1911 | 1 | 4x 6x 8 |
| U. S. Govt. Wood Pres. Plant | Keokuk, Iowa | Keokuk, Iowa | 1908 | 1 | 4x 3x42 |
| " " " " " | Milan. Ill. | Milan, Ill. | 1908 | 1 | 4x 3x42 |
| " " " " " | Stillwater, Minn. | Stillwater, Minn. | 1908 | 1 | 4x 3x42 |
| " " " " " | Fountain City, Wis. | Fountain City, Wis. | 1908 | 1 | 4x 3x42 |
| Valentine-Clark Co. | Minneapolis, Minn. | Minneapolis Transfer, | 1908 | 1 | 12x14x12 |
| | | St. Paul, Minn. | 1908 | 2 | 8 dia. x12 |
| Washington Creosoting Co. | Everett, Wash. | Everett, Wash. | 1916 | 4 | 30x 7x10 |
| Western Cedar Pole Preservers | Spokane, Wash. | Sandpoint, Idaho | 1916 | 2 | 8x24x11 |
| " " " " | " " | " " | 1916 | 1 | 5 dia. x11 |

### CANADA.

| | | | | | |
|---|---|---|---|---|---|
| Lindsley Bros. | Spokane, Wash. | Naskup, B. C. | 1910 | 1 | 6 dia. x12 |

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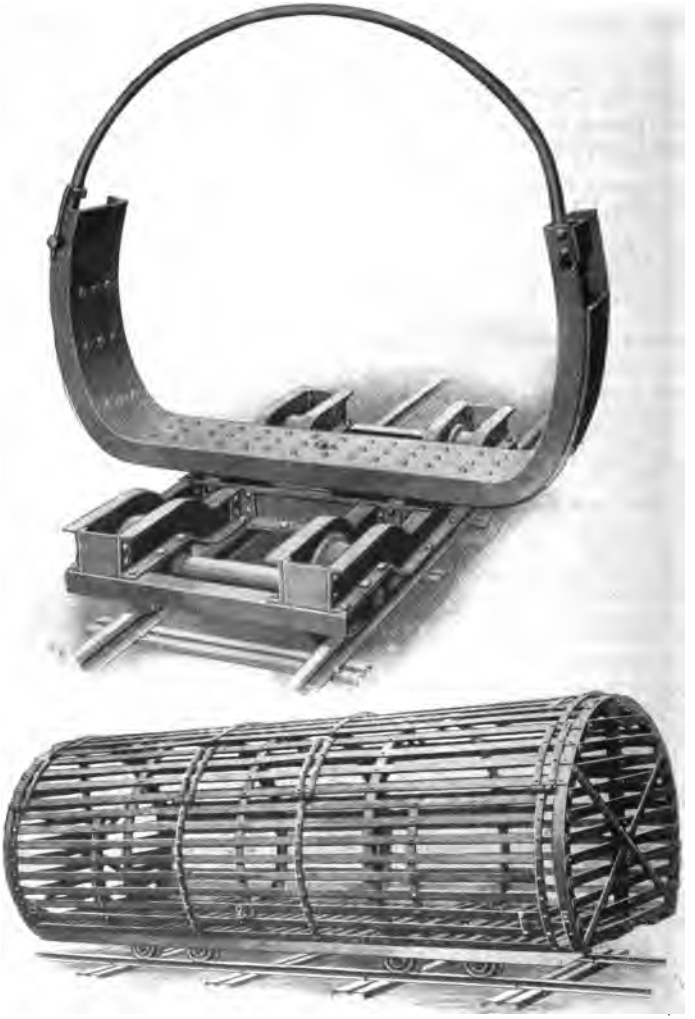

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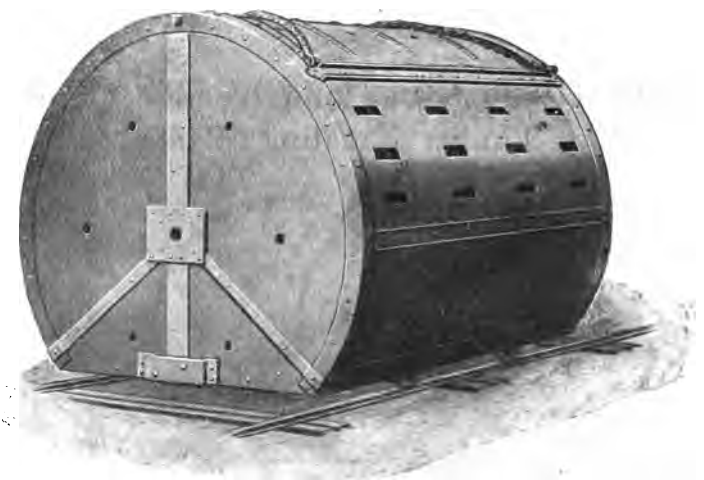

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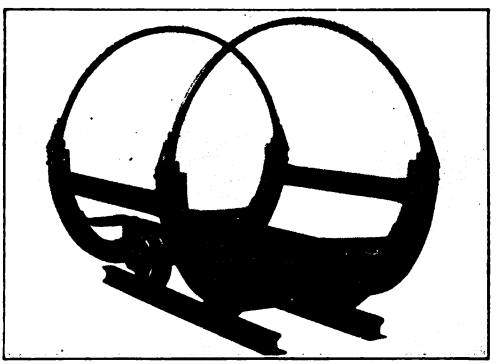

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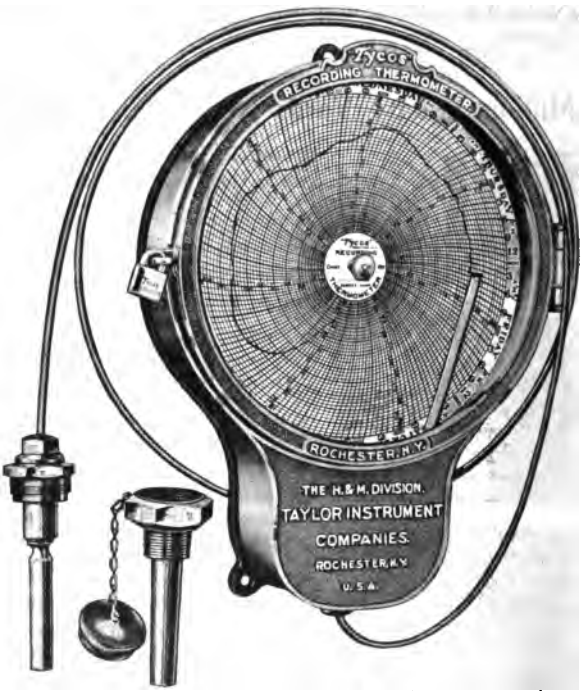


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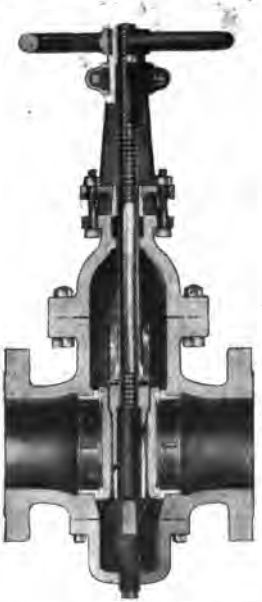

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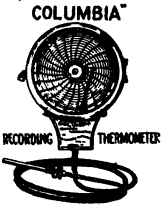


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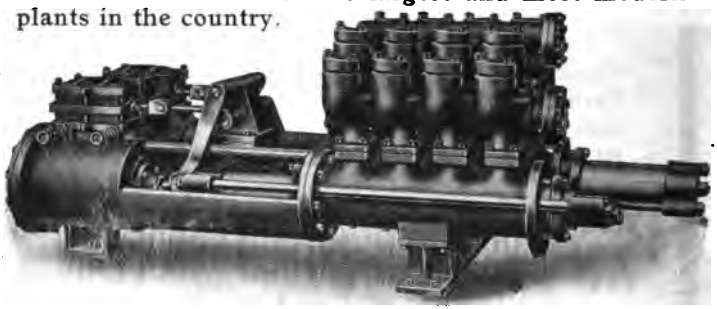

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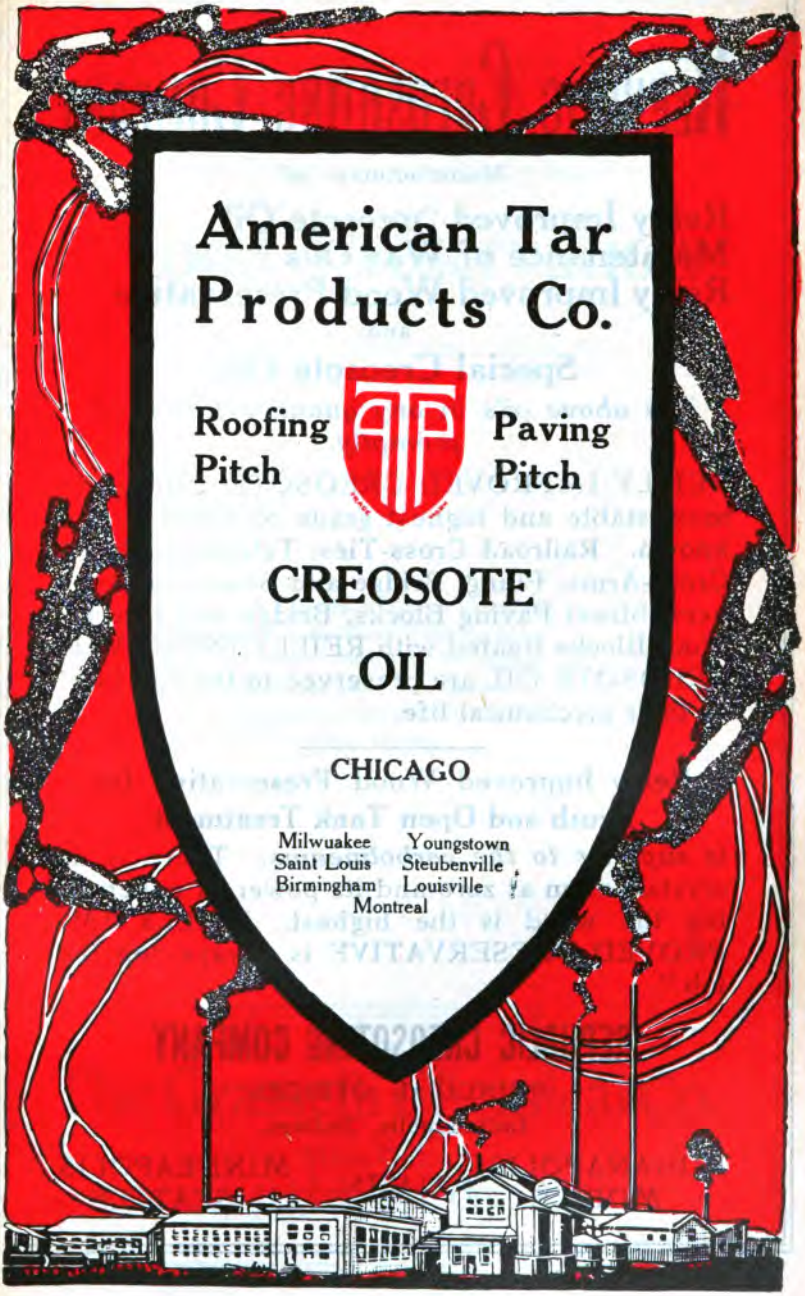


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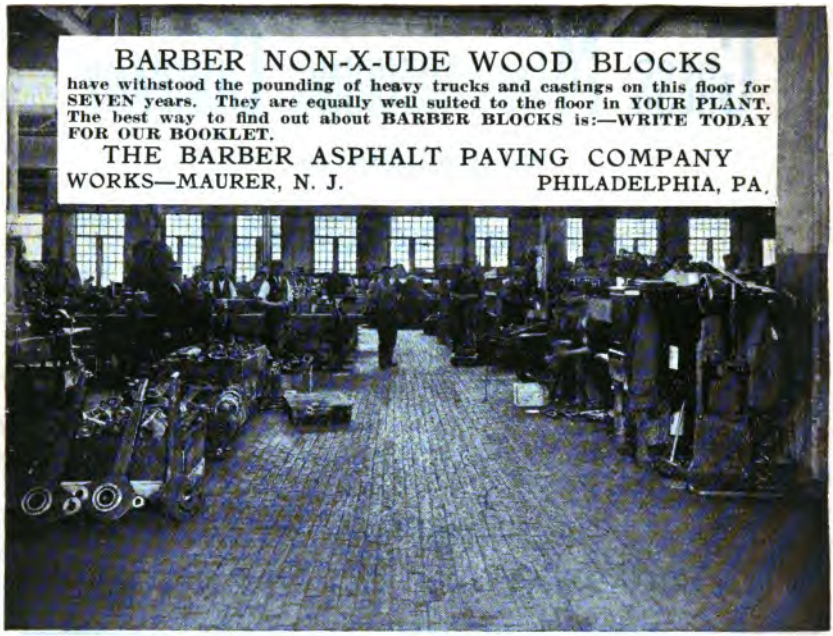
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